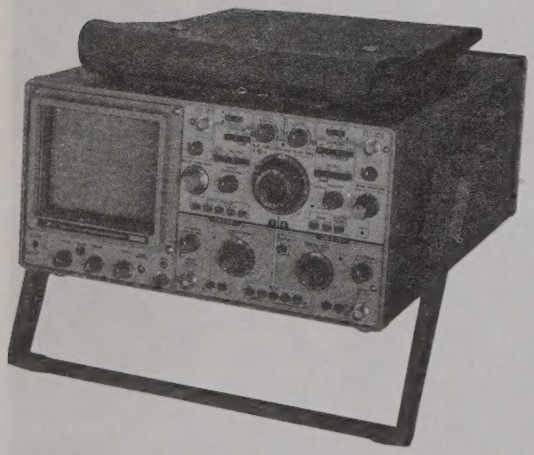
INSTRUCTION MANUAL

OSCILLOSCOPE

SS-5710

IWATSU



INSTRUCTION MANUAL

OSCILLOSCOPE

SS-5710

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Specifications

1-1 GENERAL

The SS-5710 is an oscilloscope with a frequency bandwidth of DC to 60 MHz that can display 8 traces on 4 channels. The SS-5710 is useful in a wide range of applications for not only production lines and maintenance and service purposes but also for the research and development of a variety of electronic devices. The features of the SS-5710 are as follows:

- In addition to display of 8 traces on 4 channels, the SS-5710 has an ADD function for measuring the sum of two signals and CH 2 POLAR for measurement of the difference between two signals.
- Both CH 1 and CH 2 have a high deflection factor of 1 mV/div (in the x5 MAG function), which permits accurate measurement of lower voltages.
- The horizontal deflection system has sweep rates up to 5 nS/div (in the x10 MAG function) so that even high-speed phenomena can be measured with accuracy.

The SS-5710 has delayed sweep, single sweep, ALT sweep, and X-Y operation functions, and a TV synchronizing signal separator circuit so that television and other composite video signal waveforms can be observed.

1-2 ELECTRICAL SPECIFICATIONS

1-2-1 Cathode-Ray Tube (CRT)

Shape	Rectangular, 6 inches
Dispaly Area	8 div x10 div (1 div = 10 mm), with internal illuminated graticule of parallax-free type
Phosphor	B31 (Standard)
Accelerating Voltage	Approximately 15 kV

1-2-2 Vertical Deflection System

Modes	CH 1, CH 2, ALT, CHOP, ADD, QUAD (Quadruple) CHOP switching rate: 300 kHz ±40%
Channels 1 and 2	
Deflection Factor	5 mV/div to 10 V/div, in 11 calibrated steps in a 1-2-5 sequence Accuracy: ±2% (at 10° C to 35° C) ±5% (at −10° C to 50° C) 5 mV/div to 25 V/div, continuously variable with the VARIABLE control x5 MAG: 1 mV/div to 2 V/div in 11 calibrated steps Accuracy: ±4% (at 10° C to 35° C) ±8% (at −10° C to +50° C)
Frequency Response	DC to 60 MHz, −3 dB (5 mV/div to 0.2 V/div) DC to 20 MHz, −3 dB (1 mV/div, 2 mV/div in the x5 MAG made Notes • 10° C to 35° C • AC coupling: The lowest useable frequency is 4 Hz.
Rise Time	5.8 nsec (5 mV/div) or less
Pulse Response	Overshoot: 5% or less Sag (at 1 kHz): 1.5% or less Other distortions: 5% or less (5 mV/div, 10° C to 35° C)

Signal Delay	Delay cable supplied
Input Coupling	AC, DC, GND
Input RC	Direct: 1 MΩ ±2%//32pF ±3pF With probe: 10 MΩ ±2%//15pF ± 2pF
Maximum Input Voltage	Direct: 250 V (DC +peak AC) With probe: 600 V (DC +peak AC) (Refer to the instruction manual for the probe for the maximum input voltage where probe is used.)
Drift	0.5 div/hour (5 mV/div) or 2 div/hour (1 mV/div) 30 minutes after power is turned on (Standard)
Common Mode Rejection Ratio	5 mV/div 40 : 1 (1 kHz sine wave) 15 : 1 (5 MHz sine wave)
Polarity Inversion	CH 2 only

Channels 3 and 4

Deflection Factor	0.1 V/div, 1 V/div, selectable Accuracy: ±4% (at 10 °C to 35 °C)
Frequency Response	DC to 50 MHz, −3 dB Notes • 10 °C to 35 °C • AC coupling: The lowest usable frequency is 4 Hz.
Pulse Response	Overshoot: 10% Sag (at 1 kHz): 2% Other Distortions: 10%
Input Coupling	AC, DC
Input RC	Direct: 1 MΩ ± 3%//32 pF ± 3 pF With probe: 10 M Ω±2%//15 pF ±2 pF
Maximum Input Voltage	Direct: 250 V (DC +peak AC) With probe: 600V (DC +peak AC)

1-2-3 Triggering

A-Triggering

Triggering Mode	AUTO, NORM, SINGLE/RESET
Signal Source	CH 1, CH 2, CH 3, LINE, NORM (External trigger can be used by selecting CH 3 with SOURCE switch.)
Coupling	AC, DC, HF REJ, LF REJ, FIX, TV-H, TV-V
Slope	Possitive-going (+), Negative-going (−)
Minimum Trigger Sensitivity	As shown in Table 1-1

Table 1-1 (at 10°C to 35°C)

Frequency Range	Sensitivity	
	CH 1, CH 2	CH 3, CH 4
DC to 1 kHz	1 div	1.5 div
1 kHz to 2 MHz	0.5 div	1 div
2 MHz to 20 MHz	1 div	1.5 div
20 MHz to 60 MHz	1.5 div	2 div

Note
- Fix: 1 div at 10 Hz to 2 MHz
  2 div at 2 MHz to 30 MHz
  Sine wave only
- TV-V, TV-H synchronizing signal level: 2.3 div or more on screen amplitude for a composite video signal

composed of 7 parts video signal and 3 parts synchronizing signal

- Trigger signals are attenuated in the following frequency ranges depending on coupling
  AC: 10 Hz or less
  HF REJ: 10 kHz or higher
  LF REJ: 10 kHz or lower
- AUTO sweep mode: The lowest useable frequency is 50 Hz.

B-Triggering

Signal Sources	RUNS AFTER DELAY, CH 1, CH 2, CH 4 (External trigger can be used by selecting CH 4 with SOURCE switch.)
Coupling	AC, DC, HF REJ, TV-H
Slope	Positive-going (+), negative-going (–)
Minimum Trigger Sensitivity	As showm in Table 1-1 However, Sensitivity of 20 MHz to 60 MHz is 2 div at CH 1, CH 2.

1-2-4 Horizontal Deflection System

Modes	A, A INTEN, ALT, B (DLT'D), X-Y

A-Sweep

Sweep Rates	50 nsec/div to 0.5 sec/div, in 22 calibrated steps in a 1-2-5 sequence 50 nsec/div to 1.25 sec/div, continuously variable with the VARIABLE control Accuracy I (Over center 8 divisions): ±3% at 50 nsec/div to 5 msec/div ±4% at 10 msec/div to 0.5 sec/div (at 10°C to 35°C) ±5% (at –10°C to +50°C) Accuracy II (Over any 2 of the center 8 divisions): ± 5% (at –10° C to +50°C)
Hold-Off Time	Variable with the HOLDOFF control

B-Sweep

Delay	Continuous delay (RUNS AFTER DELAY), triggered delay
Sweep Rates	50 nsec/div to 50 msec/div, in 19 calibrated steps in a 1-2-5 sequence Accuracy I (Over center 8 divisions): ±3% (at 10° C to 35° C) ±5% (at –10° C to +50°C) Accuracy II (Over 2 of the center 8 divisions): ±5% (at –10° C to +50° C)
Time Difference Measurement	0.5 μsec/div to 5 sec/div Accuracy: ±2% of reading ±0.01 graduation (Minimum graduation of DELAY TIME MULT dial)
Delay Jitter	1/20,000 or less
Sweep Magnification	10 times (Maximum sweep rate: 5 nsec/div) Accuracy I of magnified sweep rate (Over center 8 divisions) ±5% at 50 nsec/div to 0.1 μ sec/div ±4% of 0.2 μsec/div to 0.5 sec/div (at 10° C to 35° C) Accuracy II of magnified sweep rate (Over any 2 of the center 8 divisions): ±10% at 50 nsec/div to 0.1 μsec/div

	±6% at 0.2 μ sec/div to 0.5 sec/div (at 10° C to 35° C) (Except 25 nsec before and after sweep)

1-2-5 X-Y Operation

X Axis	(Same as CH 1 except for the following)
Deflection Factor	Same as that of CH 1 Accuracy: ±5% (at 10°C to 35°C) ±6% (at −10° C to +50 °C)
Frequency Response	DC to 2 MHz, −3 dB
Y Axis	same as CH 2
X-Y Phase Difference	3 ° or less (at DC to 50 kHz)

1-2-6 Z-Axis System

Sensitivity	0.5 Vp-p
Polarity	Positive decleases intensity, negative incleases intensity
Frequency Range	DC to 3 MHz
Input Resistance	5 k Ω±10%
Maximum Input Voltage	50 V (DC +peak AC)

1-2-7 Calibrator

Waveform	Square wave
Repetition Frequency	1 kHz Accuracy: ±30% (at 10 °C to 35 °C)
Duty Ratio	40% to 60%
Output Voltage	0.3 V Accuracy: ±1% (at 10°C to 35°C) ±2% (at −10 °C to +50 °C)
Output Current	10 mA Accuracy: ±2% (at 10° C to 35° C) ±3% (at −10° C to 50 °C)

1-2-8 Power Supply

Voltage Range	100V (90 to 110 V)/ 115V (103 to 128 V)/ 220V (195 to 242 V)/ 230, 240V(207 to 264 V)/ AC One of these voltage ranges can be selected with voltage selector plug
Frequency Range	50 to 440 Hz
Power Consumption	Approximately 50 W (at 100 VAC)

1-3 PHYSICAL CHARACTERISTICS

Weight	Approximately 8.5 kg (without panel cover and accessories bag)
Dimensions	320 ±2 (W) x 160 ±2 (H) x 400±2 (L) (mm) See Figure 1-1.

1-4 ENVIRONMENTAL CHARACTERISTICS

Operating Temperature	−10 °C to −50 °C
Operating Humidity	40°C, 90% Relative Humidity
Storage Temperature	−20°C to 70°C
Storage Humidity	70° C, 80% Relative Humidity

Altitude	Operating: 5,000 m maximum (atmospheric pressure 428 mm Hg) Non-operating: 15,000 m maximum (atmospheric pressure 87 mmHq)
Vibration	From 10 Hz to 55 Hz and back in 1 minute; double amplitude 0.63 mm; for 15 minutes each in vertical, horizontal, and longitudinal directions for a total of 45 minute
Impact	One side is raised to an elevation angle of 45° (10 cm maximum), and let fall on a piace of hard wood. Each side is put to this test 3 times.
Drop	A package ready for transpotation is dropped from a height of 60 cm.

1-5 ACCESSORIES

Power cord	1
Probe (SS-0011)	2
Fuse (FSA-1)	2
Panel cover	1
Dust cover	1
Instruction Manual	1
Accessories bag	1

For the method of removing the accessories bag, refer to Figure 1-2.

Figure 1-1. Dimensional Diagram

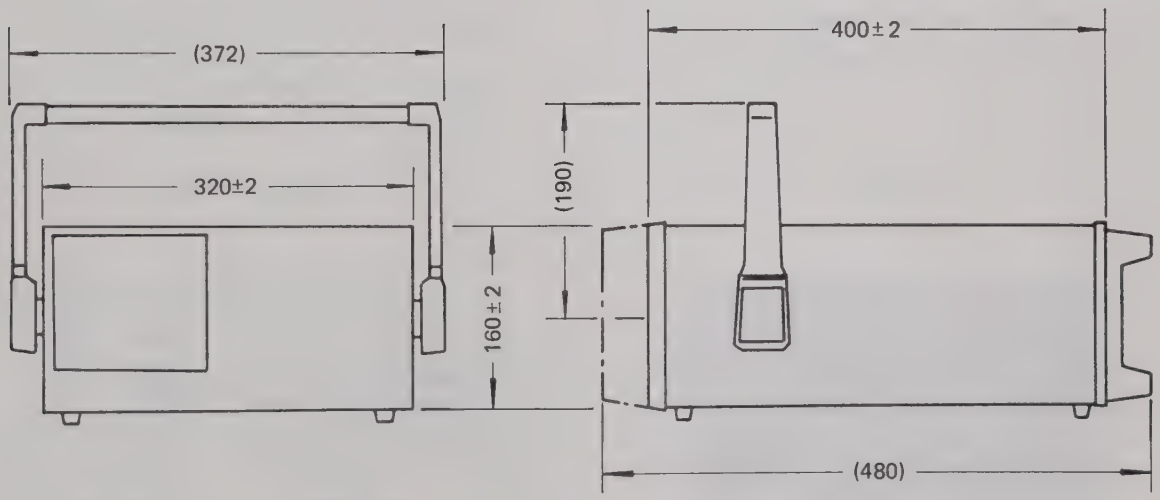
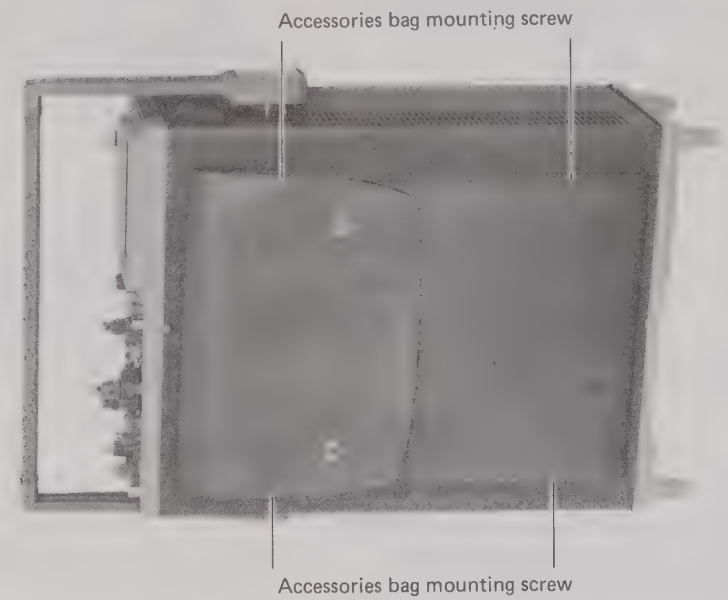


Figure 1-2. Accessories Bag



When removing the accessories bag form the upper cover of the SS-5710, remove the four accessories bag mounting screws shown in Figure 1-2.

Use the same screws for mounting the accessories bag on the upper cover again.

Operating Information

2-1 OPERATING PRECAUTIONS

Observe the following precautions in operating the SS-5710.

Ambient temperature and ventilation

The SS-5710 operates normally in the ambient temperature range of −10° C to +50° C. Be sure to use the SS-5710 within this range. Use of it outrange can result in some trouble. Do not place anything near the ventilating hole in the cover to block heat dissipation.

Line voltage check

Before plugging the power cord to an electrical output, be sure to check its voltage. The SS-5710 can be used on the line voltage shown in Table 2-1, which can be selected with the voltage selector plug on the rear panel. Also check the fuse in the rear panel as shown in Table 2-1. Operating the SS-5710 on other than the specified voltages can result in breakdown.

Before changing the voltage selector plug, or replacing the fuse, be sure to unplug the power cord from the electrical outlet.

Table 2-1

Set Position	Center Voltage	Voltage Range	Fuse
A	100 V	90 to 110 V	1 A slow-blow
B	115 V	103 to 128 V	
C	220 V	195 to 242 V	0.5 A slow-blow
D	230/240 V	207 to 264 V	

Be sure to replace the fuses with the correct ones.

The SS-5710 uses the fuses shown in Table 2-2 to protect the circuits from damage by overcurrent.

If any of these fuses is burnt out, carefully determine the cause, repair a defect if any, and replace it with the correct one. Never use fuses other then specified because it can cause not only troubles but danger.

Table 2-2

Circuit No.	Fuse Spec.	Function	Position
13F01	1 A slow-blow	Voltage selector plug A or B	Rear panel See Figure 2-4.
	0.5 A slow-blow	Voltage selector plug C or D	
13F02	1 A slow-blow	CRT circuit protection	See Figure 2-1.

Use the supplied power cord.

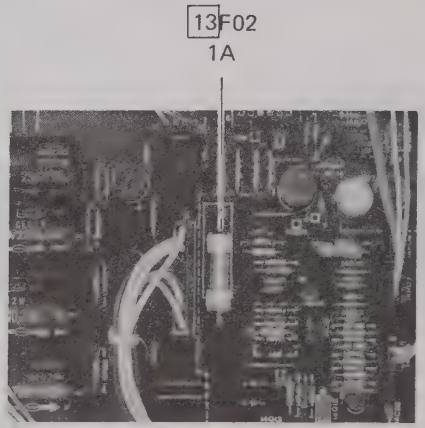
Use the supplied 3-core power cord.

When operating the SS-5710 on the line voltage form a 2-core electrical outlet with the supplied 3-core power cord and a conversion adaptor, be sure to ground the ground terminal on the rear panel to prevent danger.

Signal applies to the probes and input connectors

Be sure to connect the probe ground leads and input

Figure 2-1. Fuse Locations



connector ground terminals to the ground voltage part of the object to be measured. If they are connected to other point, the ground leads or terminals will be shorted through the SS-5710 resulting in breakage of the measuring object or the SS-5710 (including its probes). This must be absolutely avoided.

Do not increase light intensity excessively

Do not increase the light intensity of traces or spot more than necessary. Excessive light intensity can not only result in eyes fatigue but, if left for a long time, burn the CRT phosphor surface.

Using the SS-5710 with the CRT screen up

The SS-5710 can be used with the CRT screen up as shown in Figurer 2-2 (a). Be careful not to bring the SS-5710 down by pulling hard the probes connected to the signal input connector.

2-2 OPERATION OF THE HANDLE

The carring-handle of the SS-5710 can be unlocked if the rotary part (root) the handle is pused inwards (in the arrow direction) as shown in Figure 2-2 (d).

If both the right and left ends are pushed, they can be unlocked together, and the handle can be turned as it is.

If the rotary part is released, the handle is automatically locked.

The handle can be positioned as desired for carrying (as shown in Figure 2-2 (d)) or as stand for signal observation (as shown in Figure 2-2 (c)).

Fold the handle back as shown in Figure 2-2 (b), if possible, when storing the SS-5710.

2-3 CONTROLS AND SWITCHES

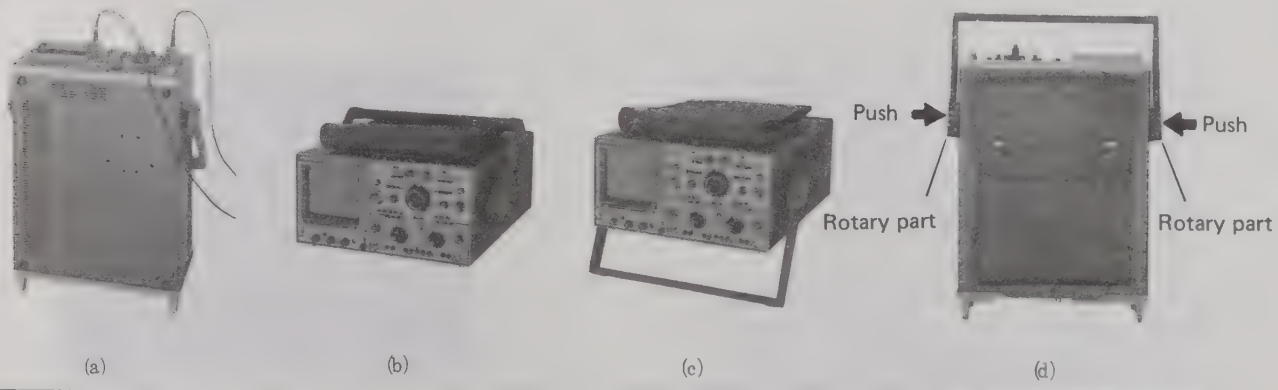
The functions of the switches and controls on the front and rear panels are explained. Refer to Figure 2-3, 2-4, and 2-5.

The front panel is color-coded. The power supply, CRT, and vertical deflection controls are dark-olive; trigger and horizontal deflection controls are light-olive.

If the VARIABLE contols for vertical deflection factor and sweep rate are set to other than the CAL position, the indicator lamp lights to indicate non-calibration.

In the description of the switches, the word IN indicate their pushed position (▬) and the word OUT their released position (▟).

Figure 2-2. How to Place the SS-5710 and Use the Handle



2-3-1 Front Panel

Power, CRT and Calibration controls

POWER ON/OFF

Power switch

INTEN

Adjust the brightness of traces or spot. Turning the control clockwise increases intensity, and turning it counterclockwise decreases intensity.

BEAM FIND

Search the trace or spot positions. If the button is pushed when a trace or spot is outside the screen, it appears on the CRT screen.

FOCUS

Focus traces or spot.

SCALE

Adjust the brightness scale. Turning it clockwise brightens the scale, and turning it counterclockwise darkens the scale.

TRACE ROTATION

Adjust traces parallel to the horizontal graticule lines.

CAL 0.3 V

Signal output terminal of a square wave with a calibration voltage of 0.3 V and repetition frequency of 1 kHz. Use for adjusting vertical axis deflection factor and probe phase.

⊥ (Ground terminal for measurement)

Signal ground terminal for measurement. Connect it to the ground terminal of the circuit to be measured.

Vertical Deflection System

POSITION (PULL x5) (CH 1, CH 2)

For position adjustment and waveform magnification. Traces and spot can be positioned with this control.
Turning the control clockwise moves traces or spot upward, and turning the control counterclockwise moves it downward,.
When the control is pulled, the vertical deflection factor is magnified 5 times.

INPUT (CH 1, CH 2)

Connector for connecting a probe or cable to apply input signal to be measured.

The maximum input voltage is 250 V (DC + peak AC) where input signals are directly applied; or 600 V (DC + peak AC) where a probe is used.
(For the maximum input voltage where a probe is used, refer to the instruction manual for probe.)

AC-DC (CH 1, CH 2, CH 3, CH 4)

Switch for selecting a signal input coupling.
AC: The vertical deflection input is AC-coupled. Even if AC input signal is superimposed on DC signal, the DC component is blocked so only the AC component is allowed to pass.
DC: The vertical deflection input is DC-coupled. All the frequency components, including DC, are allowed to pass through.

GND (CH 1, CH 2)

When the GND position is selected, input signal is not connected to the vertical amplifier, but the input circuit of the vertical amplifier is grounded. (Input signal is not grounded.) Thus, the ground voltage (normally serving as a reference level for measurement) can be easily confirmed.

UNCAL (CH 1, CH 2)

If the VARIABLE control is set to other than the CAL position, this lamp lights to indicate non-calibration.

VOLTS/DIV (CH 1, CH 2)

Set the vertical deflection factor to select one of 11 positions from 5 mV/div to 10 V/div to suit input signal level. If the x5 MAG button is pushed in at 5 mV/div or 10 mV/div, a high deflection factor of 1 mV/div or 2 mV/div can be obtained. The VOLTS/DIV switches represent the voltage (of an input signal) per division of the scale on the CRT screen where the VARIABLE control is set to the CAL position.

Figure 2-3. Front Panel

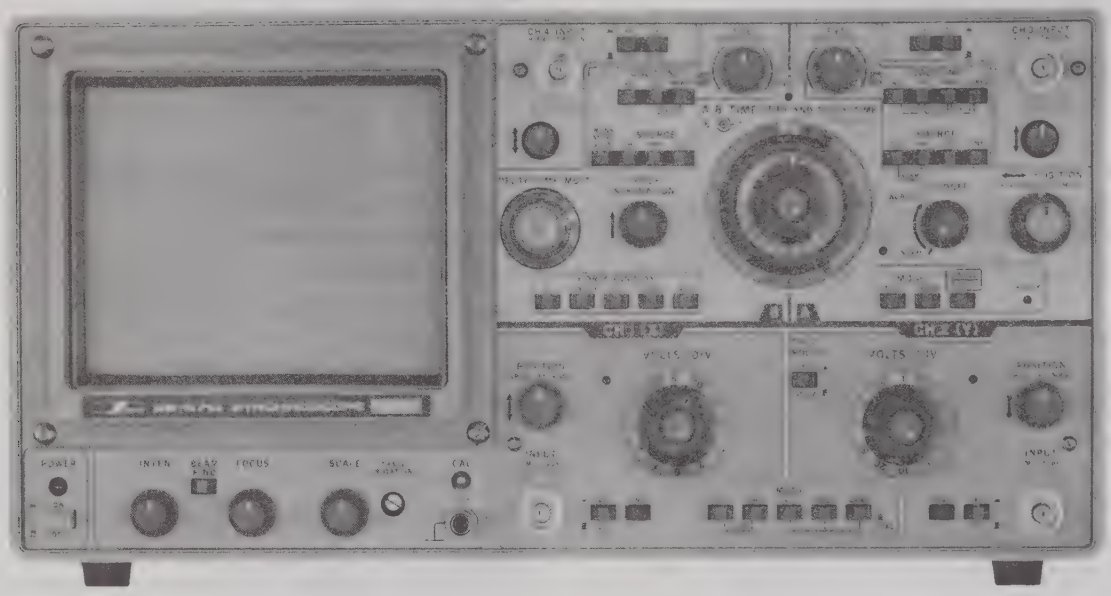
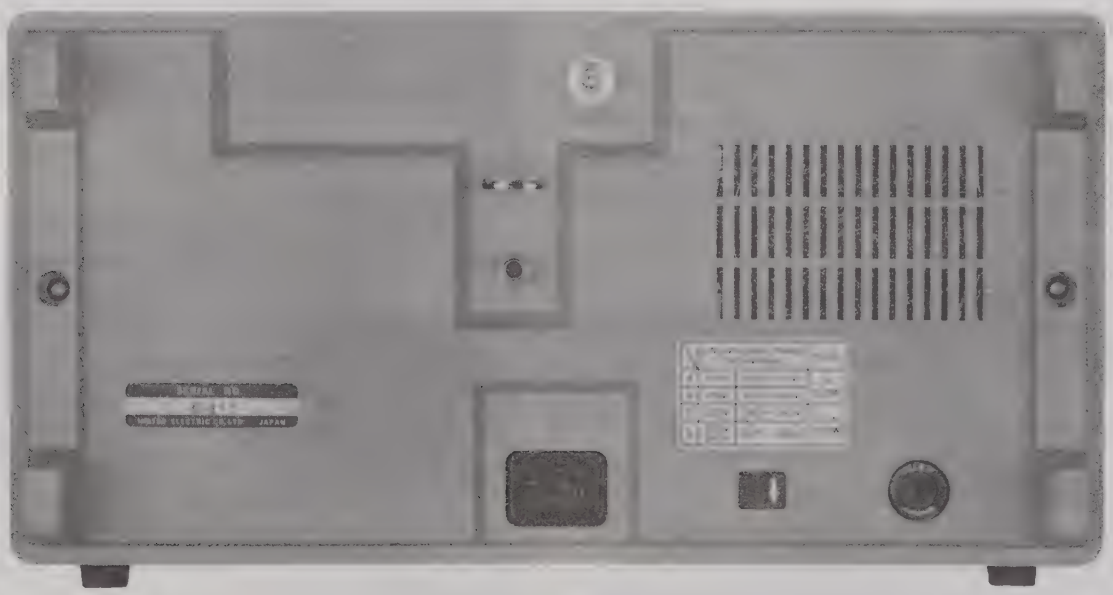


Figure 2-4. Rear Panel



VARIABLE (CH 1, CH 2)

The VARIABLE controls are used to continuously attenuate the vertical deflection factor according to input signals. The deflection factor is 1/2.5 or more when the control is turned fully counterclockwise.

CH 2 POLAR INV/NORM

Select CH 2 polarity.

NORM when the button is OUT (▟) position; INV when the button is IN (▬). where the polarity is inverted.

MODE

These MODE button are used for switching vertical deflection operation. The following modes can be selected.

CH 1: Only signal which is applied to CH 1 (x) INPUT is displayed on the CRT screen.

CH 2: Only signal which is applied to CH 2 (Y) INPUT is displayed on the CRT screen.

ALT: The two signals applied to CH 1 and CH 2 INPUT connectors are displayed on the CRT screen. This mode is suitable for observing waveforms where TIME/DIV is set to a position faster than 1 msec/div.

CHOP: The two signals applied to CH 1 and CH 2 INPUT connectors are displayed on the CRT screen. This mode is suitable for observing waveforms where TIME/DIV is set to a position slower than 1 msec/div.

ADD: The ADD mode is selected when both CH 1 and CH 2 buttons are simultaneously pushed in. This mode is used for observing the algebraic sum of the signals applied to CH 1 and CH 2 INPUT connectors or their difference. CH 1 ±CH 2 can be selected with CH 2 POLAR.

QUAD: If the QUAD button is IN when the ALT or CHOP button is IN position, quadruple traces are displayed on the CRT screen. This mode is used for simultaneously displaying the signals applied to CH 1, CH 2, CH 3, and CH 4 INPUT connectors on the CRT screen. Either of the two following quad modes can be selected.

Quad-trace display in the ALT mode: If the ALT and QUAD buttons are pushed in, ALT operation takes place to display 4 signals on the CRT screen.

Quad-trace display in the CHOP mode: If the CHOP and QUAD button are pushed in, CHOP operation takes place to display 4 signals on the CRT screen.

If the HORIZ DISPLAY ALT button is IN during the above operations, the 4 signals are displayed on the CRT screen. If the QUAD button is pushed again to the out (DUAL) position, the SS-5710 operates in the ALT or CHOP mode as indicated on the panel.

CH 3 INPUT (A EXT TRIG IN)

Connect a probe or cable for applying a signal input to be measured or an external trigger signal input for A-sweep. The maximum input voltage is 250 V (DC + peak AC) where the input signal is directly applied; or 600 V (DC + peak AC) where a probe (10 : 1) is used.

(For the maximum input voltage where a probe is used, refer to the instruction manual for probe.)

↕ (CH 3, CH 4)

Select a trace vertical position for CH 3 (CH 4) with this control. Turning it clockwise moves a trace upward, and turning it counterclockwise moves it downward.

1 V - 0.1 V(CH 3, CH 4)

Select CH 3 (CH 4) deflection factor with this control. The value indicated represents a voltage per division of the graticule on the CRT screen.

CH 4 INPUT (B EXT TRIG IN)

Connect a probe or cable for applying a signal input to be measured or an external trigger signal input for B-sweep.

The maximum input voltage is 250 V (DC + peak AC) where the input is directly applied, or 600 V (DC + peak AC) where a probe (10 : 1) is used.

(For the maximum input voltage where a probe is used, refer to the instruction manual for probe.)

Horizontal Deflection Controls

HORIZ DISPLAY

The following modes can be selected with the horizontal deflection control buttons.

A: A sweep mode for normal waveform observation. Sweep time can be selected with the A TIME/DIV switch and A VARIABLE control.

A INTEN: A delayed sweep mode (in which a part of the input signal waveform is magnified for observation)

ALT: Alternate A INTEN sweep and B sweep

B (DLY'D): A sweep delay mode (in which the part selected by delayed sweep is magnified)

X-Y: A mode in which the SS-5710 is used as an X-Y scope, CH 1 serving as X axis and CH 2 as Y axis.

MODE

This button selects either of the following trigger modes.

AUTO: In the AUTO mode, a sweep is started if trigger condition is readied; or a free-running sweep takes place otherwise.

NORM: In the NORM mode, a sweep is started if trigger condition is readied; or no sweep take place otherwise.

SINGLE/RESET: The single trigger mode. This button also has a RESET function so, no trigger signal, it puts the SS-5710 into a ready condition, which is indicated by the lighting of the READY lamp on the right.

READY

This lamp lights when the SS-5710 is in a ready state in the single sweep mode.

↔ POSITION FINE (PULL x10 MAG)

This control has position adjusting and waveform magnifying functions.

It has two kinds of knobs for position adjustment: The large grey knob for coarse horizontal position adjustment, and the small red knob for fine horizontal position adjustment. Turning the knobs clockwise moves the waveform to the right-hand, and turning them counterclockwise moves it to the left-hand.

When the small red knob is pulled, the x10 MAG function is set to magnify the waveform 10 times in the horizontal direction.

COUPLING (A-Sweep)

For selecting an A-sweep trigger coupling (trigger circuit input coupling).

AC: AC coupling is selected. Trigger signal DC component is blocked. AC signal only is used for triggering.

DC: DC coupling is selected. DC can be used for triggering.

HF REJ: Frequencies over approximately 10 kHz are attenuated by a lowpass filter. Suitable for observing signals cleared of high-frequency noise.

LF REJ: Highpass filter coupling to attenuate low frequencies under approximately 10 kHz.

Suitable for observing signals cleared a low-frequency noise.

FIX: If both the AC and DC buttons are simultaneously pushed in, the trigger level is fixed nearly at the zero point. Thus, it is not necessary to operate the LEVEL control.

TV-H: If both the DC and HF REJ buttons are simultaneously pushed in, TV-H coupling is selected. This trigger coupling is used for ovserving a composite video signal waveform over a period of 1 H by triggering with a television horizontal trigger pulse.

TV-V: If both the HF REJ and LF REJ buttons are simultaneously pushed in, TV-V coupling is selected. This trigger coupling is used for observing a composite video signal waveform over a period of 1 V by triggering with a television vertical trigger pulse.

SOURCE (A-Sweep)

Select the SOURCE of A-sweep trigger signal.

CH 1: The input signal applied to CH 1 INPUT is branched out as internal trigger signal.

CH 2: The input signal applied to CH 2 INPUT is branched out as internal trigger signal.

CH 3: The input signal applied to CH 3 INPUT is branched out as internal /external trigger signal.

LINE: The SS-5710's power line signal is used as trigger signals. This mode is used for observing line signals and line harmonics.

NORM: If both the CH 1 and CH 2 buttons are simultaneously pushed in, the NORM mode is selected, in which the signal for the waveform displayed on the CRT screen in connection with a vertical mode is used as a trigger signal. (For a detailed description of trigger signal selection, refer to the subsequent paragraph on triggering.)

HOLDOFF

This control is used for stabilized synchronization of complex (composite) pulse waveforms. Turning the control fully counterclockwise to NORM minimizes the holdoff period, and turning it clockwise continuously increases the holdoff period.

LEVEL SLOPE (PULL—) (A-Trigger, B-Trigger)

This control has trigger level setting and trigger slope selecting functions.

Push it for positive-going slope trigger level selection; or pull it for negative-going slope trigger level selection.

A TRIG'D

This lamp lights to indicate a triggering state.

A, B TIME/DIV and DELAY TIME

The outer knob is for A TIME/DIV and DELAY TIME, and the inner knob for B TIME/DIV.

The A TIME/DIV AND DELAY TIME control has 22 A-sweep positions from 50 nsec/div to 0.5 sec/div, and selects delays in A INTEN sweep or B (DLY'D) sweep. The value of each position of the control represents a sweep rate and delay time per division on the CRT screen where the A VARIABLE control is turned fully clockwise to the CAL position.

The B TIME/DIV control has 19 B-sweep positions from 50 nsec/div to 50 msec/div, but no VARIABLE control.

A VARIABLE

Provides continuously the varies A-sweep rate. If the control is turned fully counterclockwise, the value of where the TIME/DIV switch is set at least 2.5 times or more.

A UNCAL

This lamp lights to indicate that A sweep rate is uncalibrating state when A VARIABLE control is out of CAL position.

DELAY TIME MULT

This potentio-meter selects the amount of delay time between the start of A sweep and the start of B sweep.

COUPLING (B-Sweep)

For selecting a B-trigger coupling (trigger circuit coupling).

If the DC and HF REJ buttons are simultaneously pushed in, TV-H is selected.

All functiuns are the same as those of A-sweep except for LF REJ, TV-V and FIX.

SOURCE (B -Sweep)

The SOURCE buttons are used for selecting B-sweep trigger signals and a type of delay (continuous delay or triggered delay).

RUNS AFTER DELAY: When the button is IN, RUNS AFTER DELAY is selected for continuous delay.

CH 1: Function is the same as that of A-sweep.

CH 2: Function is the same as that of A-sweep.

CH 4: The input signal applied to CH 4 INPUT is branched out as trigger signal. This function corresponds to the external trigger function of a dual-trace oscilloscope.

(If the CH 1, CH 2, or CH 4 button is pushed in, the triggered delay mode is selected.)

TRACE SEPARATION

This control is used for moving the B-sweep waveform above the A INTEN sweep waveform on the CRT screen when the HORIZ DELAY button ALT is IN. If the contol is turned fully counterclockwise, the A INTEN sweep and B-sweep waveforms overlap, and when the control is turned fully clockwise, the B-sweep wavefrom moves 4 divisions or more.

2-3-2 Rear Panel

Z AXIS INPUT

Apply a signal for external intensity modulation to this input terminal. The maximum input voltage is 50 V (DC + peak AC).

CAL 10 mA

A square wave current of 1 kHz, 10 mA flows through the current loop terminal in the arrow direction (from right to left). Use its current output for checking and calibrating the current probe.

⏚ (Ground terminal for protection)

Ground terminal for protecting the oscilloscope. When supplying a line voltage from a 2-core electrical outlet, be sure to connect this terminal to the ground for preventing danger.

AC LINE INPUT

AC voltage is supplied to this connector. Connect the supplied power cord to it.

A.B.C.D (Voltage Selector plug)

Set the voltage selector plug's arrow mark to one of the A, B, C or D position to suit the AC line voltage. Refer to the table of line voltage ranges.

FUSE

Fuse holder.

2-3-3 Bottom Cover

GAIN

This is for adjusting vertical deflection factor.

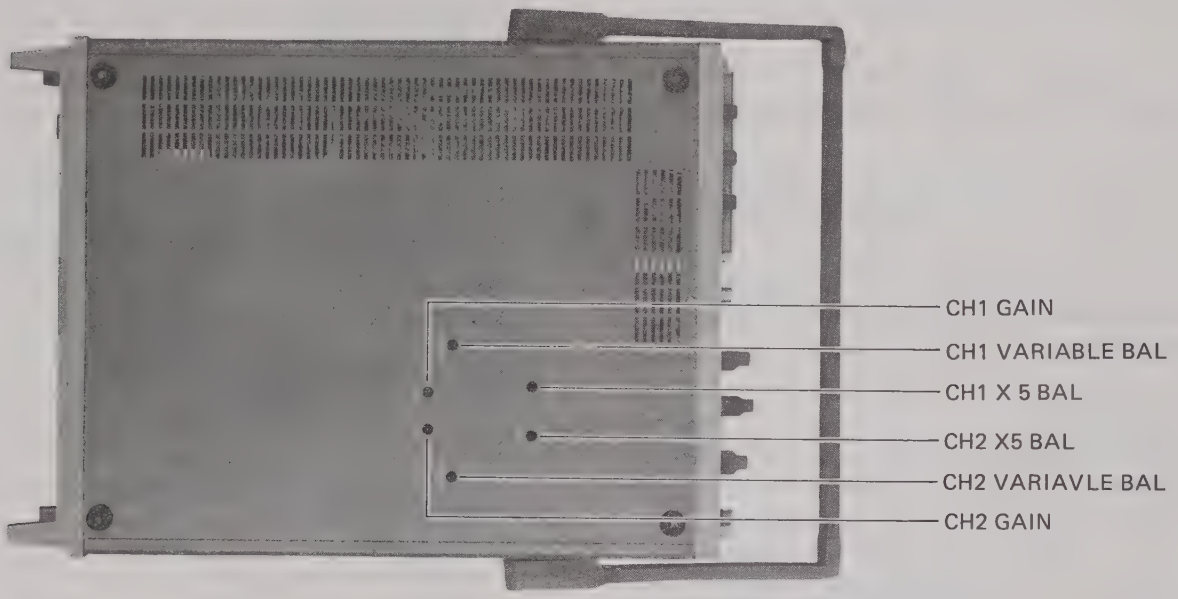
x5 BAL

This is for adjusting vertial deflection position when the PULL x5 MAG is pushed or pulled.

VARIABLE BAL

This is for adjusting the movement of vertical trace position when the vertical deflection VARIABLE control is turned.

Figure 2-5. Bottom cover



2-4 OPERATING INSTRUCTIONS

The basic operating instructions for the SS-5710 used for observing voltage waveforms are explained below.

2-4-1 Basic Operation for Signal Observation

The follwoing procedure applies where a CAL 0.3 V signal is applied to CH 1 INPUT with the supplied probe for observation.

Turning POWER On

Before connecting the power cord, check the AC line voltage with a voltmeter, and set the voltage selector plug to the proper position to suit the line voltage.

1. Set the POWER to OFF position, and connect the power cord to the AC LINE INPUT connector on the rear panel and an electrical outlet.
2. Set the controls as follows. See Figure 2-6 and 2-7.

A INTEN	Midrange
MODE (Vertical)	CH 1
AC-DC (CH 1)	AC
↕ POSITION (CH 1)	Midrange
HORIZ DISPLAY	A
MODE (Horizontal)	AUTO
←→POSITION	Midrange
FINE (PULL x10 MAG)	Midrange (button IN)

3. Push the POWER button up to the ON position. A trace is displayed in about 15 seconds. Adjust its intensity as appropriately with the INTEN control.

Focusing

4. Set the A TIME/DIV switch to the 1 msec/div position, and adjust the FOCUS control to make the trace clear and sharp.

Applying signals and triggering

5. Set the controls as follows.

COUPLING (A-Sweep)	AC
SOURCE (A-Sweep)	CH 1
VOLTS/DIV (CH 1)	5 mV
VARIABLE (CH 1)	CAL

Figure 2-6. Power, CRT and Calibration controls

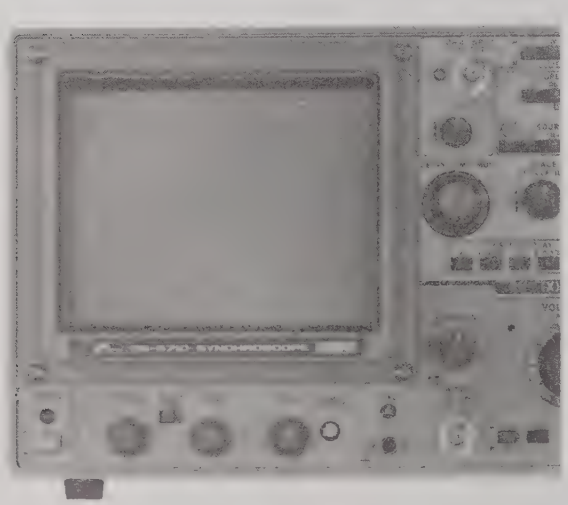
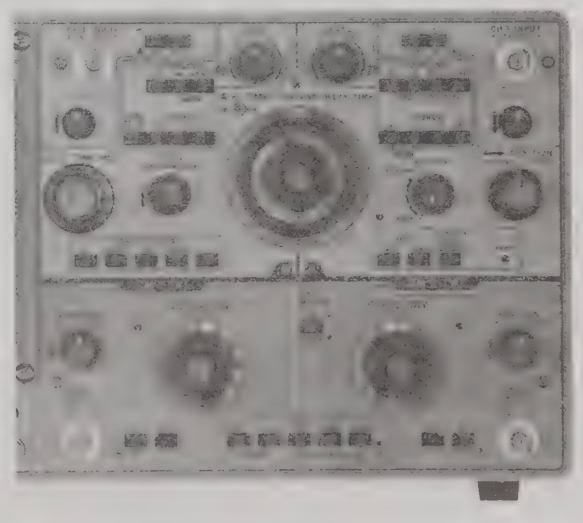


Figure 2-7. Vertical Deflection and Horizontal Deflection Controls



6. Using the supplied probe, connect CH 1 INPUT to the CAL. 0.3 V terminal.
7. Turn the LEVEL (A-Sweep) control to nearly the mid-range, and a 6-division calibration voltage waveform is displayed on the CRT screen. It is triggered by internal trigger (AC coupling) in the AUTO mode.

   For a detailed description of triggering, refer to Triggering in a subsequent paragraph.

Deflection Factor Setting

8. As VOLTS/DIV switch is turned form 10 mV, 20 mV, and on to 10 V, the deflection factor decreases so that the waveform amplitude on the CRT screen becomes small. The amplitude also decreases when the VARIABLE control is turned counterclockwise.

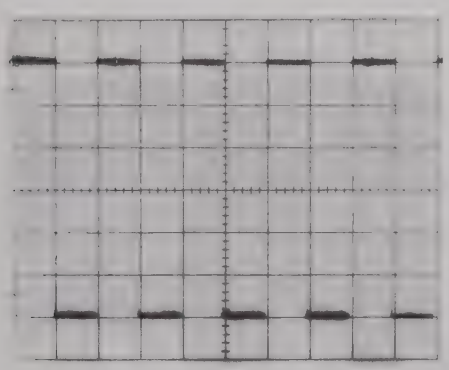
   Adjust the input deflection factor with the VOLTS/DIV switch and VARIABLE control so that the input signal has an amplitude easy to be observed on the CRT screen.

Sweep Rate Setting (A-Sweep)

9. As the A TIME/DIV switch is turned from 0.5 msec, 0.2 msec and on the 50 nsec, the displayed waveform that can be observed decreases. There are kinds of signals to be measured. To observe various signals on a suitable cycle, set an appropriate sweep rate with the A TIME/DIV switch and A VARIABLE control. For the sweep rate setting procedure, refer to the subsequent paragraph on sweep rate setting.

   The basic operation procedures for observing signal waveforms have been described above.

Figure 2-8. Calibrator waveform



2-4-2 Applying Signals

Apply the signals to be observed to CH 1, CH 2, CH 3, and/or CH 4 INPUT connectors.

Generally a passive probe is used for applying a signal to the oscilloscope.

The use of a probe prevents the waveforms on the CRT screen from being adversely affected by the induction of an external electric field. If a 10 : 1 probe is used, the input impedance is higher than where a 1:1 probe is used, and thus the load effect on the signal source is lessened. This permits accurate waveform observation in spite of a high signal source impedance.

The 10:1 probe, however, attenuates the input signal to 1/10 so the VOLTS/DIV readings of input signal amplitude must be multiplied by 10.

The 1:1 probe is suitable for observing low-frequency low-level signals because a large load effect is produced on high-frequency signals.

(For a detailed description of the probe, refer to Section 3 MEASURING PROCEDURES and the instruction manual for probe.)

2-4-3 Signal Input Coupling Selection

Kinds of signals, including DC, AC, and AC superimposed on DC, may be applied for observation. For accurate observation of these kinds of signals, select the proper signal input coupling with the AC-DC switch.
(See Figure 2-9 and 2-10.)
AC Coupling:
In AC coupling, a DC signal is blocked by a capacior so that only the AC signal passes it. Thus, the AC signal waveform will be out of the screen by the DC voltage so it can be observed with its amplitude increased on the screen. If a signal with a low repetition frequency is observed in the AC coupling mode, a sag appears in the waveform if the signal is a square wave; or if it is a sine wave, the amplitude on the screen is attenuated about –3 dB

per 4 Hz from the actual one.

DC Coupling:

DC coupling is selected for observing all the frequency components of a signal input.

Ground Coupling:

The input of the vertical amplifier circuit is grounded so a ground level trace is displayed on the screen. The ground level normally serves as reference level in measurements.

2-4-4 Vertical Deflection Factor Setting

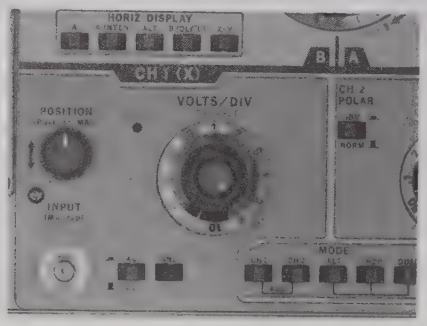
To observe a signal waveform, it must be displayed with an appropriate amplitude on the CRT screen.

The CH 1 and CH 2 VOLTS/DIV switches are deflection factor select switches, and their VARIABLE controls are for fine adjustment of deflection factor. (See Figure 2-9.)

If the VARIABLE controls are turned fully clockwise to the CAL position, the positions of the VOLTS/DIV switches directly indicate the selected deflection factors, which represent the voltage per division of the screen scale for the signal waveforms displayed.

The deflection factor select switches for CH 3 and CH 4 have two position, 0.1 V/div and 1 V/div, but no VARIABLE controls. (See figure 2-10.)

Figure 2-9. CH 1 VOLTS/DIV switch and VARIABLE control



2-4-5 Triggering

It is necessary to have a correct understanding of the triggering procedure in using an oscilloscope.

The triggering procedure for A-sweep (where the HORIZ DISPLAY button A is IN) is described below. The triggering procedure for B-sweep that is necessary in delayed sweep operation is described in the subsequent paragraph on Waveform Magnification Operation.

The following must be set for A-sweep triggering.

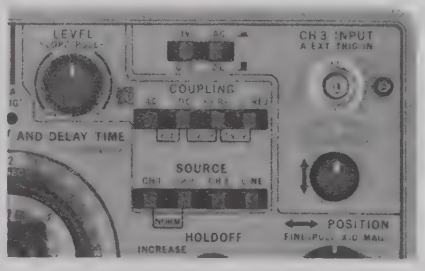
- Trigger Signal
  Selects CH 1, CH 2, CH 3, NORM, or LINE with the SOURCE button.
- Trigger Coupling
  Selects AC, DC, HF REJ, LF REJ, FIX, TV-H, or TV-V with the COUPLING button.
- Trigger system
  Selects AUTO, NORM, or SINGLE-RESET with the MODE switch.
- Slope
  Selects either positive-going (+) or negative-going (−).
- Level
  Selects a suitable trigger level.
- Hold off
  Selects a suitable HOLD OFF time.

A detailed description of the above 6 items is given below.

Trigger Signal

To observe an input signal waveform, it is necessary to

Figure 2-10. CH 3 0.1 V-1 V and AC-DC switches



apply an input signal, or a signal which has a constant time relationship with the input signal (called a trigger signal), to the trigger circuit to drive it.

Select internal trigger (CH 1, CH 2, CH 3, NORM), external trigger (CH 3), or line trigger (LINE) with the SOURCE button.

Input signal applied to input connector is brached off from vertical deflection system and method that applies it to the trigger circuit is called internal trigger.

The input signal is also used as internal trigger circuit. Thus, operation is simple.

The method of applying an external input signal, or a signal which has a constant time relationship with the input signal, to the trigger circuit is called external trigger. External trigger has the follwing advantages.

- External trigger is unaffected by the channel to which an input signal is applied. In the internal trigger mode, the trigger signal amplitude changes whenever the deflection factor is changed, and thus the trigger level must be adjusted accodingly. In the external trigger mode, once trigger condition is established, the signals remain synchronized even if the signal to be measured changes in amplitude.
- If desired a specific time before, or after, an input signal waveform, apply this signal as trigger to EXT TRIG IN (CH 3) so that the desired waveform can be observed.

The mothod of applying a line waveform from the built-in power transformer to the trigger circuit is called line trigger, which is used for observing line waveforms and line high frequencies.

Internal Trigger (CH 1, CH 2, CH 3, NORM)

If SOURCE CH 1 is selected, the input signal that is applied to CH 1 is used as trigger signal.

If SOURCE CH 2 or CH 3 is selected, the input signal that is applied to CH 2 or CH 3 is used as trigger signal.

If SOURCE NORM (CH and CH 2 pushed in simultaneously) is selected, the input signal applied to CH 1 is used as trigger signal in the CH 1 vertical mode, or the input signal applied to CH 2 is used as trigger signal in the CH 2 vertical mode. In the ALT vertical mode, the input signal applied to CH 1 triggers CH 1, and that applied to CH 2 triggers CH 2. Alternate use of trigger signals to suit the display on the screen is convenient for comparison of waveforms. In the CHOP or ADD mode, use CH 1, CH 2, or CH 3 instead of NORM because trigger is generally unstable.

External Trigger (CH 3)

If SOURCE CH 3 is selected, the input signal that is applied to CH 3 is INPUT (A EXT TRIG IN) is used as external trigger signal.

Line Trigger (LINE)

If SOURCE LINE is selected, line trigger is available.

Trigger Coupling

The COUPLING button is used for selecting a coupling for the trigger circuit input. AC, DC, HF REJ, LF REJ, FIX, TV-H, or TV-V can be selected. Select one of them steady triggering according to the kind of trigger signal(AC, DC, composite video signal, etc.).

AC: The trigger circuit input is AC-coupled so the DC component of the trigger signal is blocked. Thus, only the AC component of the trigger signal is used for triggering. Generally, AC coupling is convenient, but triggering is difficult if the trigger frequency is below 10 Hz.

DC: The trigger circuit input is DC-coupled for DC triggering. If a AC trigger signal is superimposed on DC, whose voltage is outside the trigger level range, trigger is ineffective.

HF REJ: The trigger circuit input comprises a lowpass filter which rejects high-frequency trigger signals (over about 10kHz) and high-frequency noises mixed with high-frequency signals and passes only low-frequency components.

LF REJ: The trigger circuit input comprises a high pass filter which rejects low-frequency trigger signals (over about 10 kHz) and low-frequency noises mixed with the trigger signals, and passes only high-frequency components.

FIX: The trigger circuit input is AC-coupled and the trigger level is fixed nearly at 0 V, so trigger takes place without operating the LEVEL control.

TV-H: Uses a television horizontal synchronization pulse for triggering in observing signals over a period of 1H.

TV-V: Uses a television vertical synchronization pulse for triggering in observing composite video signals over a period of 1 V.

Trigger System

The SS-5710 offers selection of the trigger mode of AUTO, NORM, or SINGLE/RESET.

AUTO: Auto trigger is selected. If a trigger signal with the

proper frequency and level is applied to the trigger circuit, trigger condition can be readed by turning the LEVEL control to an appropriate trigger level. In the following cases, however, free-running sweeps occur due to the absence of trigger condition.

1. No trigger signal.
2. A tigger signal too small.
3. The LEVEL control set out of the trigger signal used.
4. A trigger signal with a frequency below 50 Hz.

NORM: Normal trigger is selected. If a trigger signal with the proper frequency level is applied to the trigger circuit, trigger condition can be readied by turning the LEVEL control to an appropriate triggerlevel.

In the following cases, however, sweeps stop and the instrument gets into a ready condition due to the absence of trigger condition.

1. No trigger signal.
2. A trigger signal too small for the LEVEL control to match its level.
3. The LEVEL control set out of the trigger signal used.

SINGLE-RESET: Single sweep mode. For details, refer to the subsequent description of the single sweep mode.

SLOPE

Push the LEVEL control for triggering from a positive-going slope, or pull it for triggering from negative-going slope.

LEVEL

If the LEVEL control is neary at the midrange trigger level is set place at neary 0 V.

The trigger level moves in the positive (+) direction as the LEVEL control is turned clockwise, or in the negative (–) direction as the control is turned counterclockwise. (See Figure 2-11.)

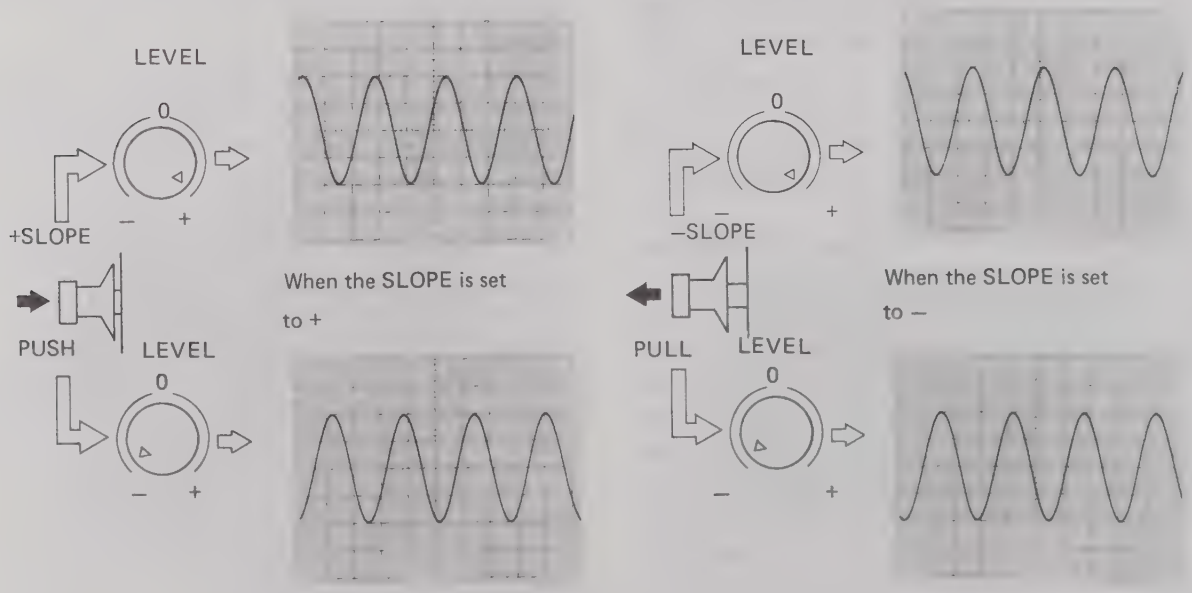
In the coupling mode FIX, the trigger level is fixed nearly at 0 V. Thus, it is not neccessary to operate the LEVEL control for triggering.

HOLDOFF

Complex waveforms of a pulse train may appear overlapped despite synchronization depending on sweep rate setting.

If that occurs, turn the HOLDOFF control from the NORM position (fully counterclockwise) toward INCREASE to change the holdoff time. If the HOLDOFF control is

Figure 2-11.



adjusted to start a sweep at the basic input signal cycle, the wave-forms are displayed in a way easy to observed.

2-4-6 Sweep Rate Setting

Many kinds of signals, some with a low repetition frequency and some with a high one, and some pulses with a fast rise and some with a low rise, may be measured. To measure these kinds of signals, it is necessary to select a suitable sweep rate.

When measuring signals with a low repetition frequency or slow rise pulses, for example, select a low sweep rate; and when measuring signal with a high repetition frequency or fast rise pulses, select a high sweep rate.

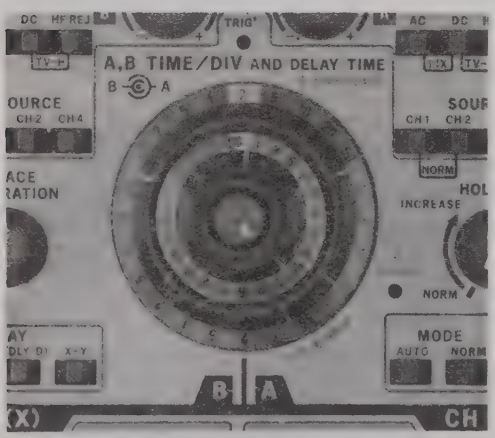
If the HORIZ DISPLAY mode A is selected, A-sweep (normal sweep) takes place. In this case, operate the A-sweep controls.

The sweep rate control used in the A-sweep mode is A TIME/DIV, and its VARIABLE control is for sweep rate fine adjustment. (see Figure 2-12.)

If the A VARIABLE control is turned fully clockwise to the CAL position, each position of the A TIME/DIV switch directly represents the sweep rate it indicates. If the A VARIABLE control is turned fully counterclockwise, the sweep rate pointed by the A TIME/DIV switch is 2.5 times the indicated value or less.

The sweep rate control used in the B-sweep mode is B TIME/DIV, which has no VARIABLE control.

Figure 2-12. TIME/DIV and A VARIABLE Controls



2-5 APPLIED OPERATIONS FOR SIGNAL OBSERVATION

The Oscilloscope SS-5710 has various convenient functions for signal observation. The following operating instructions for observing signals by use of its various functions are based on the assumption that you have sufficiently understood the basic operation procedures.

2-5-1 Operation for Dual-trace Observation

As described in the section on basic operations, the SS-5710 used as a dual-trace oscilloscope can display two signals to be measured on the CRT screen. Either ALT (alternate sweep) or CHOP (chopped sweep) can be selected for dual-trace observation. By using the ALT or CHOP mode as appropriate, dual-trace observation can be made at rates ranging from low to high speed.

Dual-Trace observation in the ALT mode

The ALT mode is suitable for observing two signals that have a high frequency. In this mode, a sweep occurs alternately between CH 1 and CH 2 so dual traces can be observed by applying two signals to CH 1 and CH 2 INPUT connectors.

The alternate sweep mode covers the full TIME/DIV range so a slow sweep rate makes dual-trace observation difficult.

Select the CHOP mode mentioned below when observing low-frequency signals.

Dual-Trace observation in the CHOP mode

The CHOP mode is suitable for dual-trace observation of low-frequency signals. CH 1 and CH 2 sweep are switched from one to the other about every 300 kHz so that, contrary to the ALT mode, it is difficult to observe high-frequency signals because their traces turn into dotted lines. Use the ALT mode for high-frequency signals.

2-5-2 Operation for Observation of the Sum of Two Signals or Their Difference

Observation in the ADD Mode

The ADD mode is selected if the vertical MODE buttons CH 1 and CH 2 are simultaneously pushed in. If signals are applied then to CH 1 and CH 2 INPUT connectors, the sum of the two signals (CH 1 + CH 2) can be observed. If the CH 2 POLAR button is pushed in to the INV position then, the difference between the two signals [(CH 1) + (−CH 2)] can be observed.

The deflection factor can be independently adjusted for CH 1 and CH 2 in the ADD mode so select a range to suit the purpose.

In the ADD mode, the ↕ POSITION controls for CH 1 and CH 2 may be used for adjusting trace positions, but for accurate measurement, the two POSITION controls should be kept nearly at the center.

2-5-3 Operation for Quadruple-Trace Observation

The SS-5710 can simultaneously display up to four

Figure 2-13. Dual-trace observation in the ALT mode

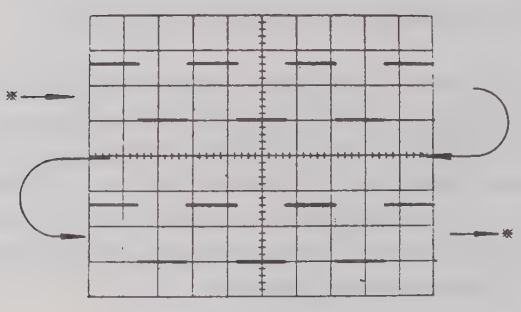


Figure 2-14. Dual-trace observation in the CHOP mode

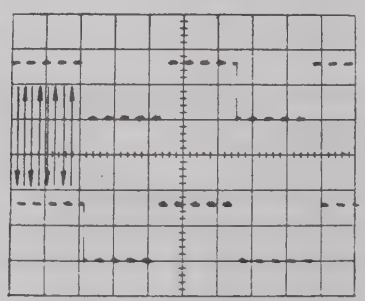


Figure 2-15. Quadruple-trace observation

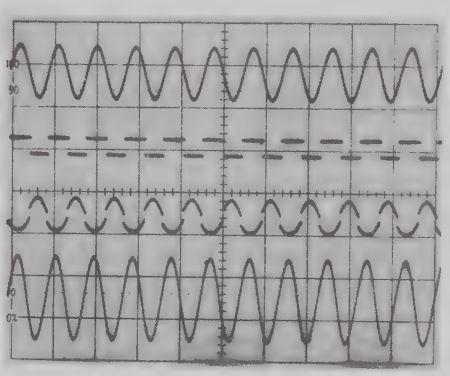
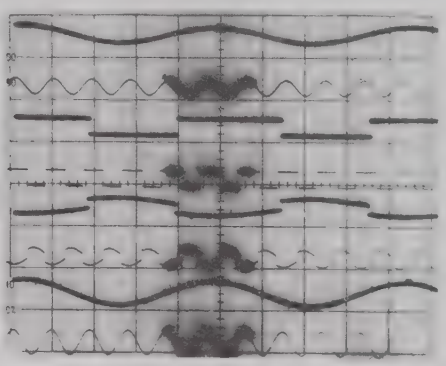


Figure 2-16. Quadruple-trace observation in the ALT mode



signals on the CRT screen aside form the dual-trace capability.

If the vertical MODE buttons ALT and QUAD, or CHOP and QUAD are simultaneously pushed in, traces for CH 1, CH 2, CH 3, and CH 4 are displayed on the CRT screen. Thus, by applying the four signals to be measured to the respective input connectors, the four signals can be simultaneously observed.

If the HORIZ DISPLAY mode ALT is selected under this condition, 8 traces are displayed on the screen as shown in Figure 2-13, giving A INTEN and B sweeps for the respective channels.

The vertical axis of quadruple traces is displayed by chopped operation if the vertical MODE buttons CHOP and QUAD are pushed in, or by alternate operation if the vertical MODE buttons ALT and QUAD are pushed in. When observing signal faster than 1 msec/div, push the vertical MODE buttons CHOP and QUAD IN. When observing signal slower than 1 msec/div, push the vertical MODE buttons ALT and QUAD IN.

2-5-4 Operation for Enlarging Waveform on the CRT Screen

Waveforms on the CRT screen can be partially magnified timewise (in the horizontal axis direction) for detailed observation by any of the following three methods.

- To use a fast sweep tate
- To use the x10 MAG function to magnify.
- To use the delayed sweep function to magnify.

These are explained in detailed below.

Using a fast sweep rate

Use a fast sweep rate to magnify the leading end of the waveform on the screen timewise. If the center part or tailing end of the waveform is magnified by using a fast sweep rated, those parts will go out of the CRT screen. In such a case, use the x10 MAG function to magnify the waveform.

Magnifying waveforms by x10 MAG

This method is mainly used to magnify the center part or tailing end of waveforms timewise.

Move the desired part to the center of the CRT screen with the horizontal POSITION control, and pull the FINE (PULL x10 MAG) knob so the desired part is magnified 10 times in the horizontal direction. The trace length at this time is approximately 10 divisions on the CRT screen, but is actually increased to approximately 100 divisions, and can be observed from end to end with the horizontal POSITION and FINE controls.

This method is simple, but magnification is limited to 10 times. The sweep rate to be used for extended observation is the value indicated by the TIME/DIV switch multiplied by 1/10.

Thus, the fastest sweep rate can be extended to 5 nsec/div.

Extending waveform by delayed sweep

The method of magnifying waveform in above paragraph is simple. It can increases the displayed sweep speed by 10 times, but it is limited to 10 times.

The method of magnifying waveform by delayed sweep can magnify every part of the waveform displayed magnifier ratio between A sweep and B sweep is determined by

$$\frac{\text{A TIME/DIV (sec/div)}}{\text{B TIME/DIV (sec/div)}}$$

but this method is limited frequency of input signal. If an input signal has a high frequency and if the A TIME/DIV switch is at the fastest speed before magnification, the waveform cannot be magnified any more.

Therefore, delayed sweep magnified is suitable for enlarging the desired part of an input signal that has a relatively low frequency.

Delayed sweep magnification comes in continuous delay and trigger delay as described below.

Continuous Delay: Operation for continuous delay is as follows:

1. Select the HORIZ DISPLAY mode A , apply an input signal, and triggering.
2. Turn the B TIME/DIV switch to a position faster than the A TIME/DIV switch.
3. Select the B-sweep SOURCE mode RUNS AFTER DELAY.
4. Select the HORIZ DISPLAY mode A INTEN'

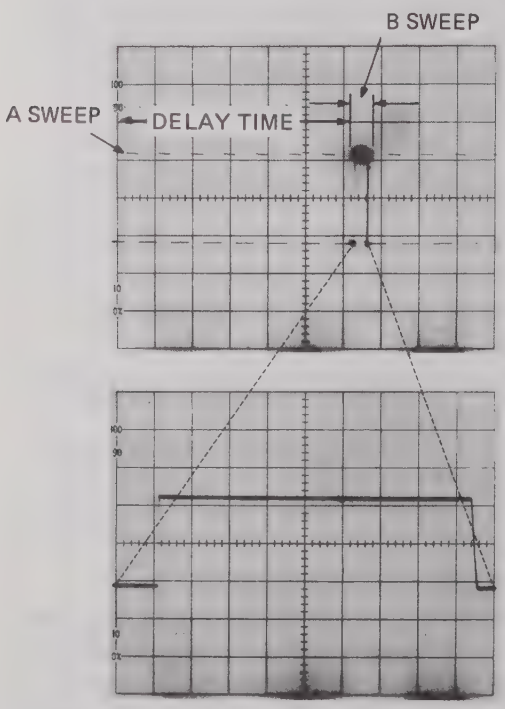
If the DELAY TIME MULT dial is turned clockwise after taking the above steps, a particularly intensity maduration part appears as shown in the upper waveform of Figure 2-17, and moves continuously from left to right. If this intensity moduration part is moved to a position where

is measured, and if the HORIZ DISPLAY mode B (DLY'D) is selected, that part can be magnified fully on the CRT screen as shown in the lower waveform of Figure 2-17.

Use the B TIME/DIV switch for selecting a B (DLY'D) sweep rate. The magnification ratio increases as the sweep rate is increased. If the magnification ratio is raised so much delay jitter showns, making waveform observation difficult. Thus, there are limitations on magnified waveform observation by countinuous delay due to delay jitter. In such a case, use the trigger delay described below if a higher magnification ratio is desired.

The delay time of the magnified part can be calculated by multiplying the indicated value of A TIME/DIV switch by the indicated value of the DELAY TIME MULT dial. Trigger Delay: Trigger delay can be selected if the B-sweep SOURCE switch is set to CH 1, CH 2 or CH 4 (if a trigger signal is applied to CH 4). Delayed magnification can be made by B-sweep triggering and performing the same steps of operation as those of continuous delay.

Figure 2-17. Magnification by Continuous Delay



The magnified part (B-sweep) in trigger delay starts at a trigger point subsequent to the delay time selected with the DELAY TIME MULT dial. The trigger point moves as DELAY TIME MULT is turned.

If DELAY TIME MULT is turned during a B (DLY'D) sweep, the waveform may appear still, but actually you are watching the part selected in the A INTEN sweep mode.

B-Sweep Trigger

The B-sweep trigger controls include B-sweep COUPLING SOURCE, and LEVEL.

The LEVEL and COUPLING (except for LF REJ, TV—V) functions and operations are the same as the A-sweep LEVEL and COUPLING functions and operations. The SOURCE button is used for selecting a trigger signal. RUNS AFTER DELAY is for continuous delay; and CH 1, CH 2 and CH 4 (external trigger function of the conventional oscilloscope) are for trigger delay. If CH 4 is selected, apply a trigger signal to CH 4 INPUT. If CH 1, CH 2 is selected, the same function as in the A-sweep mode is performed.

2-5-5 Operation for ALT Sweep

In the ALT sweep mode, an A INTEN sweep and a delayed B-sweep occur alternately. Thus, a non-magnified part and a magnified part can be simultaneously observed. The operation procedure is as follows:

1. Select the HORIZ DISPLAY mode A, apply an input signal, and synchronize.
2. Set B TIME/DIV switch to a position faster than that of A TIME/DIV switch.
3. Set the B-sweep SOURCE switch to RUNS AFTER DELAY.
4. Set the HORIZ DISPLAY switch to ALT.
5. Move the B-sweep waveform to the position where the A-sweep waveform is measured, using the DELAY TIME MULT dial.
6. Turn the B TIME/DIV switch, and magnify.
7. Move the B-sweep waveform (magnified waveform) to a point where it is easy to observe as shown in Figure 2-18, using TRACE SEPARATION.

Note. If TRACE SEPERATION is turned fully counterclockwise, the A-sweep waveform and B-sweep (magnifi-

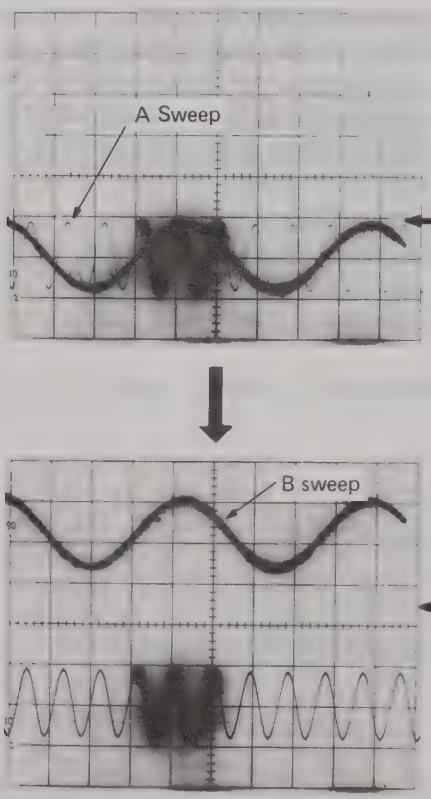
ed) waveform are completely double. When it is turned fully clockwise, the B-waveform moves about 4 divisions or more above the A-sweep waveform.

The delay time of the magnified part can be easily obtained in the same sweep by the formula shown in the above paragraph on waveform magnification by delay. If the magnification ratio is increased, jitter shows on the CRT screen. In that case, set the SOURCE button to other than RUNS AFTER DELAY for trigger delay as in B (DLY'D) sweep.

2-5-6 Operation for Observing Television Composite Video Signal Waveforms

The SS-5710 has a television synchronizing separator circuit so that television and other composite video signal waveforms can be displayed. The operation procedure is as follows.

Figure 2-18. TRACE SEPARATION Adjustment



Observation by Normal Sweep

1. Set the controls as follows:

HORIZ DISPLAY	A
Vertical MODE	CH 1 or CH 2 (whichever a signal is applied to)
COUPLING	TV-V (when observing a V signal)
	TV-H (when observing an H signal), or
SOURCE (internal trigger)	CH 1 or CH 2 (whichever a signal is applied to) or

Figure 2-19. Where H Trigger Signal is Positive

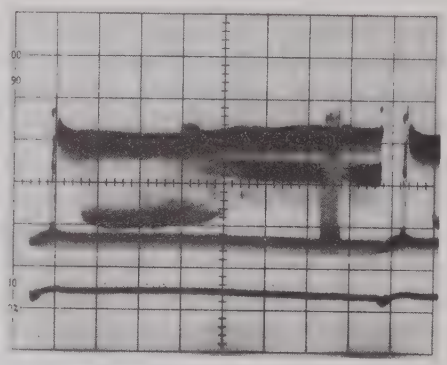
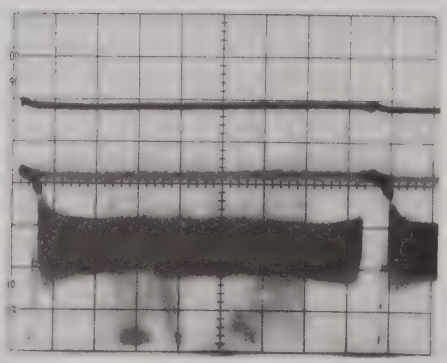


Figure 2-20. Where V Trigger Signal is Positive



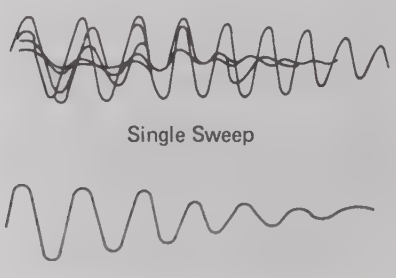
NORM
(external trigger) CH 3 (Apply a signal to CH 3 INPUT.)

2. Apply the composite signal to be measured to CH 1. CH 2 or CH 3.
3. Adjust so that the composite video signal waveform has an amplitude of 1 division or more (30% of the trigger signal component) on the screen.
4. Selects the horizontal mode AUTO or NORM.
5. Turns the SLOPE control to the + position if the trigger signal component of the composite video signal measured is positive-going; or to the -position if it is negative-going, (Refer to Figure 2-19 and 2-20.)
6. Turn the TIME/DIV switch to display the desired part of the signal on the screen.

Magnified Observation by Delayed Sweep

1. In continuation of the above steps, set the HORIZ DISPALY switch to A INTEN.
2. Turn A TIME/DIV switch to 2 msec/div.
3. When observing by continuous delay, set the B-sweep SOURCE button to RUNS AFTER DELAY; or when trigger delay is desired, set it to CH 1 or CH 2 or CH 4. (Apply the trigger signal to CH 4 INPUT if CH 4 is selected.)
4. Select the desired part to be magnified, using DELAY TIME MULT.
5. Set the HORIZ DISPLAY switch to B (DLY'D), and select the desired magnification ratio with B TIME/DIV switch.
6. The SS-5710 has no 1st-2nd field switching function, but it can be accomplished with an accuracy of about 50% by shifting the AC-DC button or by pushing or pulling the SLOPE control.

Figure 2-21. Example of Repeated Sweep and Single Sweep Waveforms



2-5-7 Operation for Single Sweep

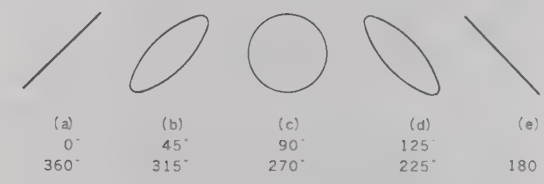
In observing discharge waveforms or fast-speed transient phenomena, such as the chatterings of an operating relay, the waveforms are displayed one upon another. If waveform is displayed at a slower sweep rate, transient phenomena can not be observed in detail. If the signale sweep function is used for obsering such phenomena, the transient phenomena can be observed without being double and photographed. (See Figure 2-21.)

The basic operation procedure for single sweep using a calibrate or voltage is described below.

1. Select the HORIZ DISPLAY mode A and the horizontal mode NORM.
2. Using one of the supplied probes, apply a CAL 0.3 V to INPUT, set VOLTS/DIV to 5 mV and synchronize.
3. Select the horizontal mode SINGLE, and push the SINGLE/RESET button, and confirm that only a single sweep takes place.
4. Disconnect the input signal, and push the SINGLE/RESET button. Confirm that the READY lamp on the right lights.

If the READY lamp lights after these steps, the oscilloscope is in a sweep standby state, ready to make a single sweep if a trigger signal is applied. (The oscilloscope may not be in a standby state if the LEVEL control is at some

Figure 2-22. Lissajou's Figure of Sine Wave



point near the center. If so, turn the LEVEL control slightly counterclockwise or clockwise.) If a transient signal is applied to the oscilloscope, it sweeps only once, display the correct waveform.

The single sweep function is effective also in the A INTEN and B (DLY'D) sweep modes. If an external trigger signal is applied and the same operations as in the internal trigger mode are taken, a single sweep is also available. A dual-trace simultaneous single sweep can be mode in the CHOP mode, but, not in the ALT mode.

2-5-8 Operation for Use as X-Y Scope

By performing operations for use as an X-Y scope, phase differences, Lissajours' figures of various frequency ratios, and hysteresis curves can be observed.

The SS-5710 operates as an X-Y scope, and a spot appear nearly at the center of the screen when the HORIZ DISPLAY mode X-Y is selected.

If signals are applied to CH 1 and CH 2 INPUTs, the signal applied to CH 1 drives the horizontal axis (X) and the signal applied to CH 2 drives the vertical (Y) axis, thus desc ribing a Lissajous' figure.

The X-axis deflection factor is adjusted with the CH 1 VOLTS/DIV switch and its VARIABLE control; and the Y-axis deflection factor with the CH 2 VOLTS/DIV switch control and its VARIABLE contol. If the VARIABLE controls are set to the CAL position, the deflection factors are as indicated by the VOLTS/DIV switches,. Vertical position can be adjusted with the CH 2 ↕ POSITION control, and horizontal position with the ←→ POSITION control and its FINE controls

Figure 2-22 and 2-23 show Lissajou's figure of measuring sine waves and different frequencies. As shown in these figures, varied waveforms are displayed depending on phase difference and frequency ratio. These waveforms are observed still.

Figure 2-24 shows examples Lissajou's figure of difference waveforms.

2-5-9 Z Axis System

In addition to the vertical (Y) axis and horizontal (X) axis, there is also a Z axis (which modulates intensity but does not affect the waveform displayed) for displaying electrical phenomena. The SS-5710 has Z AXIS INPUT on the rear panel which is fed to the CRT circuit to modulate the intensity of waveform displayed on the CRT screen.

If an input voltage of 0.5 Vp-p or more is applied, the intensity is modulated. A negative input signal increases the intensity, and a positive input signal decreases it. The frequency range is from DC to 3 MHz, and the maximum input it voltage is 50 V (DC + peak AC.)

A time reference for the waveform displayed can be obtained by applying a time marker to Z AXIS INPUT. Sweep rate can be calibrated by use of the time marker, even if observing input signal at uncalibrated sweep rate.

Figure 2-23. Lissajou's Figures of Various Frequency Ratios

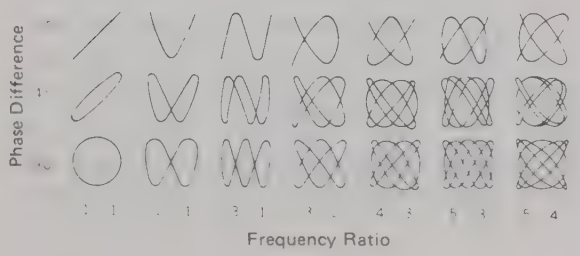
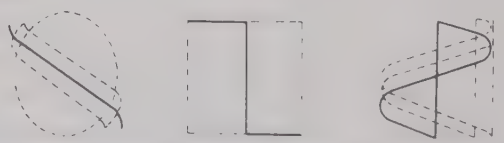


Figure 2-24. Lissajou's Figure of Different Waveforms

(Frequency ratio 1 : 1)



(a) Sine wave and triangle wave

(b) Sine wave and square wave

(c) Sine wave and sawtooth wave

Notes

Measuring Instructions

3-1 ADJUSTMENTS NECESSARY BEFOR MEASUREMENT

It may be necessary to adjust the adjusters on the front panel and bottom before attempting measurements in order to assure accuracy of measurements. In case of measuring with a probe, its phase adjustment is necessary. Whichever the case, the adjusting screwdriver (supplied as an accessory to the probes) may be used for adjustment purposes.

About 30 minutes of warmup is recommended for stabilizing operation before adjusting the controls and probe phase.

3-1-1 TRACE ROTATION Adjustment

Trace may become not parallel to the graticule lines on the CRT screen due to geomagnetic effect or other cause.

If that occurs, display a trace on the CRT screen, move it to the center of the screen with POSITION, and adjust the trace parallel to the graticule lines with TRACE ROTATION. Before making this adjustment, install the SS-5710 in the normal place of use for measurements.

3-1-2 GAIN Adjustment (CH 1, CH 2)

Vertical deflection check and adjustment are necessary to assure accuracy of voltage measurements.

The check and adjustment method is as follows. Set VOLTS/DIV switch to 5 mV, and connect INPUT to the CAL 0.3 V output terminal with an accessory probe. Check that the amplitude of the waveform displayed on the CRT screen is 6 divisions. If it is not rating, adjust it with the GAIN. (See Figure 2-5.)

3-1-3 x5 BAL Adjustment (CH 1, CH 2)

If ambient temperature fluctuations are variable, the vertical position of a trace can shift when ↕ POSITION is pushed or pulled.

If that occurs, adjust the X5 BAL while pushing and pulling ↕ POSITION so that the trace will not deviate from its vertical position. (See Figure 2-5.)

3-1-4 VARIABLE BAL Adjustment (CH 1, CH 2)

If ambient temperature fluctuations are variable, the vertical position of a trace may shift when the vertical deflection VARIABLE control is turned.

If that occurs, adjust the VARIABLE BAL while turning the VARIABLE control so that the trace will not deviate from its vertical position. (See Figure 2-5.)

3-1-5 Probe Phase Adjustment

10 : 1 Passive probe phase adjustment

The following probes can be used for the SS-5710: Type SS-0011 (1.5 m long) with an attenuation ratio of 10 : 1; SS-0001 (1 m long), SS-0002 (1.5 m long), and SS-0003 (2 m long), the later three with an attenuation ratio of 1 : 1. (Those probes with an attenuation ratio of 1 : 1 are optional.)

A mismatched probe phase can result in measuring the wrong waveform. Be sure to correctly adjust the probe before use.

First, set VOLTS/DIV to 5 mV., connect the probe to INPUT and the CAL 0.3 V output terminal so that a calibration voltage waveform with an amplitude of 6 divisions is displayed on the CRT screen.

Next, turn the variable capacitor of the probe. The waveform changes as shown in figure 3-1 b or c. Adjust the variable capacitor correctly until the waveform is as shown in Figure 3-1 a.

Current probe sensitivity check

When using a current probe for measurement, check its sensitivity beforehand.

Read the instruction manual for the current probe for the checking procedure. The SS-5710 has the CAL 10 mA current loop termianl on the rear panel, where a square wave current of 10 mA flows in the arrow direction.

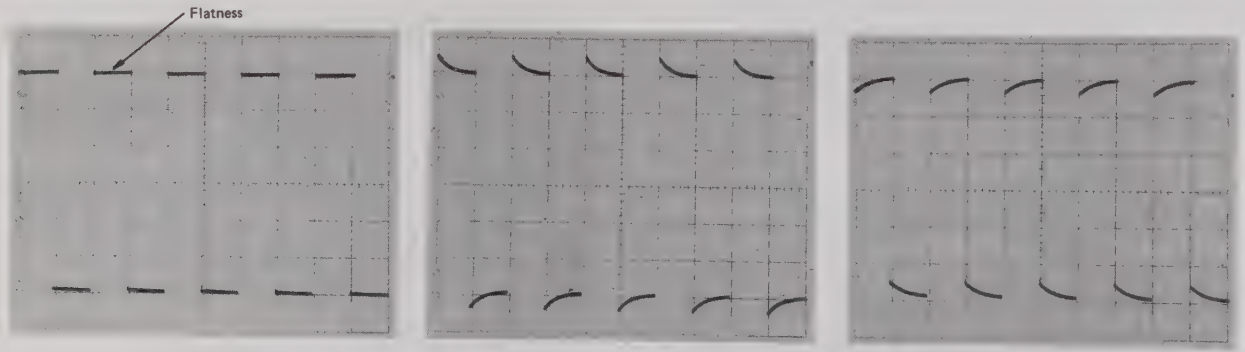
3-2 MEASURING METHODES

3-2-1 Voltage Measurement

Quantitative Measurement

The quantitative measurement of voltage can be made by setting the VOLTS/DIV VARIABLE control to the CAL position. The measured value can be calculated by Equation (3-1)or (3-2).

Figure 3-1. Probe phase waveforms



a. Correct compensation b. Excessive compensation c. Insufficent compensation

Figure 3-2. DC Voltage Measurement

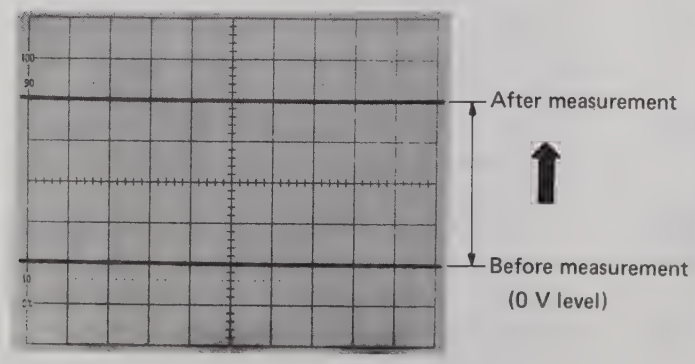
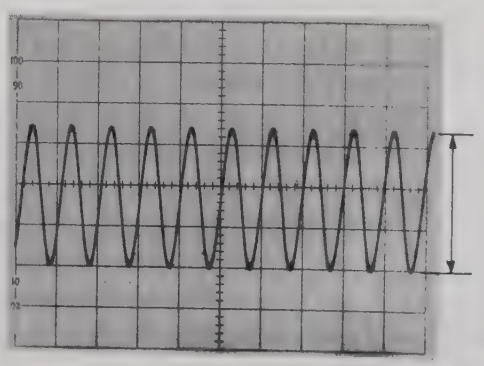


Figure 3-3. AC voltage measurement



a. Measurement with the x1 position of the probe;
Voltage (V) = VOLTS/DIV setting value (V/div)
x Displayed amplitude of input signal (div)
. . . . . (3-1)

b. Measurement with the x10 position of the probe;
Voltage (V) = VOLTS/DIV setting value (V/div)
x Displayed amplitude of input signal (div) x10 . . . . . (3-2)

DC Voltage Measurement

This instrument functions as a high input resistance, high sensitivity, quick response DC volt meter in order to measure DC voltage. Measurement procedure is as follows:

1. Set the sweep MODE switch to AUTO. and select a sweep rate so that the trace may not flicker.
2. Set the AC-GND-DC switch to GND. The vertical position of the trace in this case is used as 0-volt reference line as shown in Figure. 3-2. Adjust the vertical POSITION control in order to place the trace exctly on a horizontal graticule, which facilitates the reading of signal voltage.
3. Set the AC-GND-DC switch to DC, and apply the voltage to be measured to the input connector. The vertical diaplacement of the trace gives the voltage amplitude of the signal. When the trace shifts upward, the measured voltage is positive with regard to the ground potential. When the trace shifts downward, the voltage is negative. The voltage can be obtained by Equation (3-1) or (3-2).

AC Voltage Measurement

The measurement of the voltage waveform is performed as follows; Set the VOLTS/DIV switch in order to obtain the amplitude for easy reading, read the amplitude as shown in Figure 3-3 and calculate by Equation (3-1) or (3-2).

When the waveform superimposed on DC current is measured, set the AC-GND-DC switch to DC in order to measure the value including DC component, or set this switch to AC in order to measure AC component only.

The measured value by means of this procedure is peak value (Vp-p). Effective value (Vrms) of a sine wave signal can be given by Equation (3-3.)

$$\text{Effective voltage (V rms)} = \frac{\text{Peak voltage (V p-p)}}{2\sqrt{2}} \quad \ldots(3\text{-}3)$$

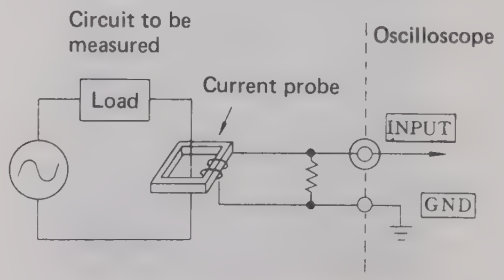
3-2-2 Current Measurement

Phanomena that can be observed by direct input application to the oscilloscope are voltage phenomena. All electrical phenomena other than voltage phenomena, such as mechanical vibrations and all others, require conversion into voltages for applying to INPUT.

In current measurements, a resistor of a known value is added to the circuit to be measured, and voltage variations at both ends of the resistor are observed on the CRT screen of the oscilloscope. The current value is calculated from the relationship V = IR. The resistor to be added to the circuit must have a resistance within a range in which the circuit will not change in operating condition. In case a resistor cannot be added to the circuit to be measured for reasons of operation, a current probe may be used for measuring currents without disconnecting the circuit. As shown in Figure 3-4, the current at the measuring point is detected by the core and secondary winding, and is applied to the vertical deflection system of the oscilloscope.

When measuring a small current, the output of the secondary winding is amplified and then applied. When measuring a large current, a shunt is inserted to apply a divided current. Otherwise, the core will be saturated. This method, however, is subject to limitation in frequency bandwidth. That is, it is unusable for high-frequency signals. if the circuit is ungrounded, a single inptut cannot assure

Figure 3-4. Current waveform measurement with current probe



accurate current measurement. That is, a differential input amplifier is necessary in that case. As mentioned in the paragraph on Operation for observation of the Sum of Two Signals or their Differnce, the SS-5710 can be used for differentical observation. This capability may be used in the following way. Select the vertical mode ADD, and CH 2 POLAR INV. Connect a probe to CH 1 and CH2 INPUTs, and its tips to both ends of the resistor inserted. Turn the VOLTS/DIV switches for CH 1 and CH 2 to the same position. The waveforms for both ends of the resistor i e., current waveforms, can now be observed.

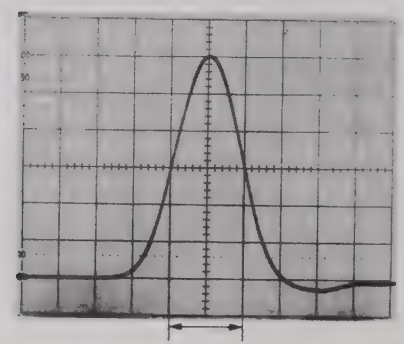
3-2-3 Time Measurement

The time interval of two points on a signal waveform can be calculated as follows: Set the TIME/DIV VARIABLE control to CAL. read the setting values of the TIME/DIV and x5 MAG switches and calculate the time by Equation (3-4).

Time (s) = TIME/DIV setting value (s/div)
x Length corresponding to the time to be measured (div)
x Reciprocal number of x5 MAG setting value. . . . . (3-4)

Where, the reciprocal number of the x5 MAG setting value is 1 when the sweep is not magnified, and 1/5 when the sweep is magnified.

Figure 3-5. Pulsewidth measurement



Pulsewidth Measurement

The basic pulsewidth measurement procedure is as follows:

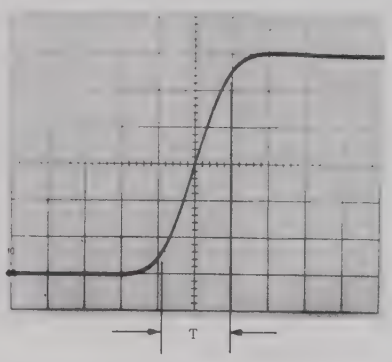
1. Display the pulse waveform vertically so that the distance between the top part of the pulse waveform and the horizontal center line of the graticule may be equal to the distance between the bottom part of the pulse and the horizontal center line as shown in Figure 3-4.
2. Set TIME/DIV switch in order to make the easy observation of the signal.
3. Read the distance between centers of rising and falling edges, i.e., the distance between two points at which pulse edges cross the horizontal center line of the graticule. Calculate the pulsewidth by Equation (3-4).

Rise (or Fall) Time Measurement

The rise (or fall) time measurement of the pulses is obtained as follows.

1. Display the pulse waveform vertically and horizontally in the same manner as for the pulsewidth measurement procedure.
2. Turn the horizontal POSITION control in order to set the upper 10% point of the waveform on the vertical center line of the graticule. (In Figure 3-5, the upper 10% point is 0.4 division below the top of the pulse since the displayed amplitude is 4 divisions.) Read the distance T_1 between the vertical center line and the point at which the rising (or falling) edge crosses the

Figure 3-6. Rise (or fall) time measurement



horizontal center line.

3. Shift and set the lower 10% point of the waveform to the vertical center line of the graticule as shown by the dotted line in Figure 3-5. Read the distance T_2 between the vertical center line and the point at which the rising (or falling) edge crosses the horizontal center line.
4. Calculate the rise (or fall) time by substituting the sum of T_1 and T_2 for Equation (3-4).

3-2-4 Frequency Measurement

Of the frequency measurement procedure, there are the following methods.

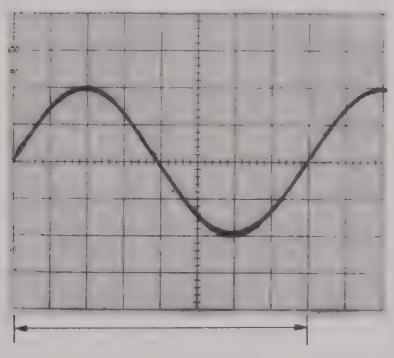
The first method: Calculate the one-cycle time (interval) of the input signal by Equation (3-4) as shown in Figure 3-6, and obtain th frequency by Equation (3-5).

$$\text{Frequency (Hz)} = \frac{1\ (c)}{\text{Period (s)}} \quad \ldots\ldots\ldots\ldots\ldots (3\text{-}5)$$

The second method: Count the repetition number N per 10 divisions in the viewing area, and calculate the frequency by Equation (3-6).

$$\text{Frequency (Hz)} = \frac{N\ (c)}{\text{TIME/DIV setting value (s/div)} \times 10\ \text{(div)}} \quad \ldots (3\text{-}6)$$

Figure 3-7. Frequency measurement (1)



When N is large (30 to 50), the second method can give a higher accuracy level than that obtained with the first method. This accuracy is approximately equal to the rated accuracy of sweep rate. However, when N is small, the count below decimal point becomes very ambiguous, which results in considerable error.

For the measurement of comparatively low frequencies having a simple pattern such as sine wave, square wave, triangle wave, and sawtooth wave, measurement with high accuracy can be effected by the follwing method: Operate the oscilloscope as an X-Y scope, make the Lissajou's pattern by applying the signal of which frequency is known, and read the necessay value.

3-2-5 Phase Difference Measurement

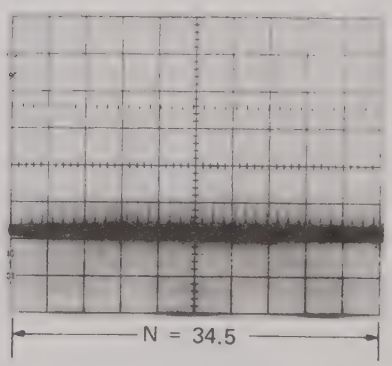
Of the measurement of phase difference between two signals, there are the follwing two methods:

The first one is the Lissajou's pattern method by using the instrument as an X-Y scope. The phase difference of signals can be calculated form the amplitudes A and B of the pattern shown if Figure 3-8 and by Equation (3-7).

$$\text{Phase defference (deg)} = \sin^{-1}\frac{A}{B} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3\text{-}7)$$

The second method is an application of dual-trace function Figure 3-9 shows an example of dual-trace display of leading and lagging sine wave signals having the same

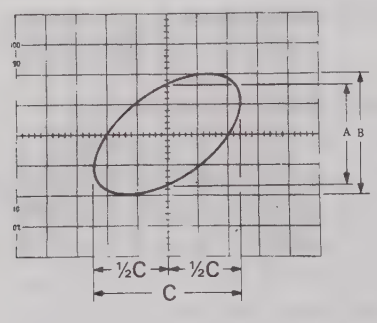
Figure 3-8. Frequency measurement (2)



frequency. In this case, the SOURCE switch must be set to a channel which is connected to the leading signal, and set the TIME/DIV switch so that the length of 1-cycle of the displayed sine wave may be 9 divisions.

Then, 1-division graticule represents a waveform phase of 40° (1 cycle =2π =360°). The phase difference between the two signals can be easily calculated by Equation (3-8).

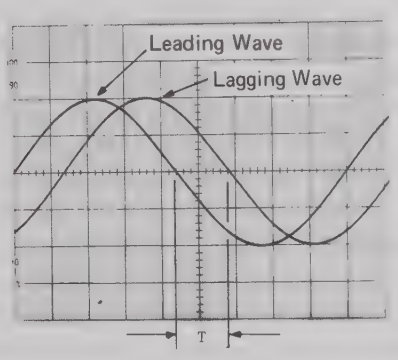
Figure 3-9 Phase difference measurement using Lissajou's pattern

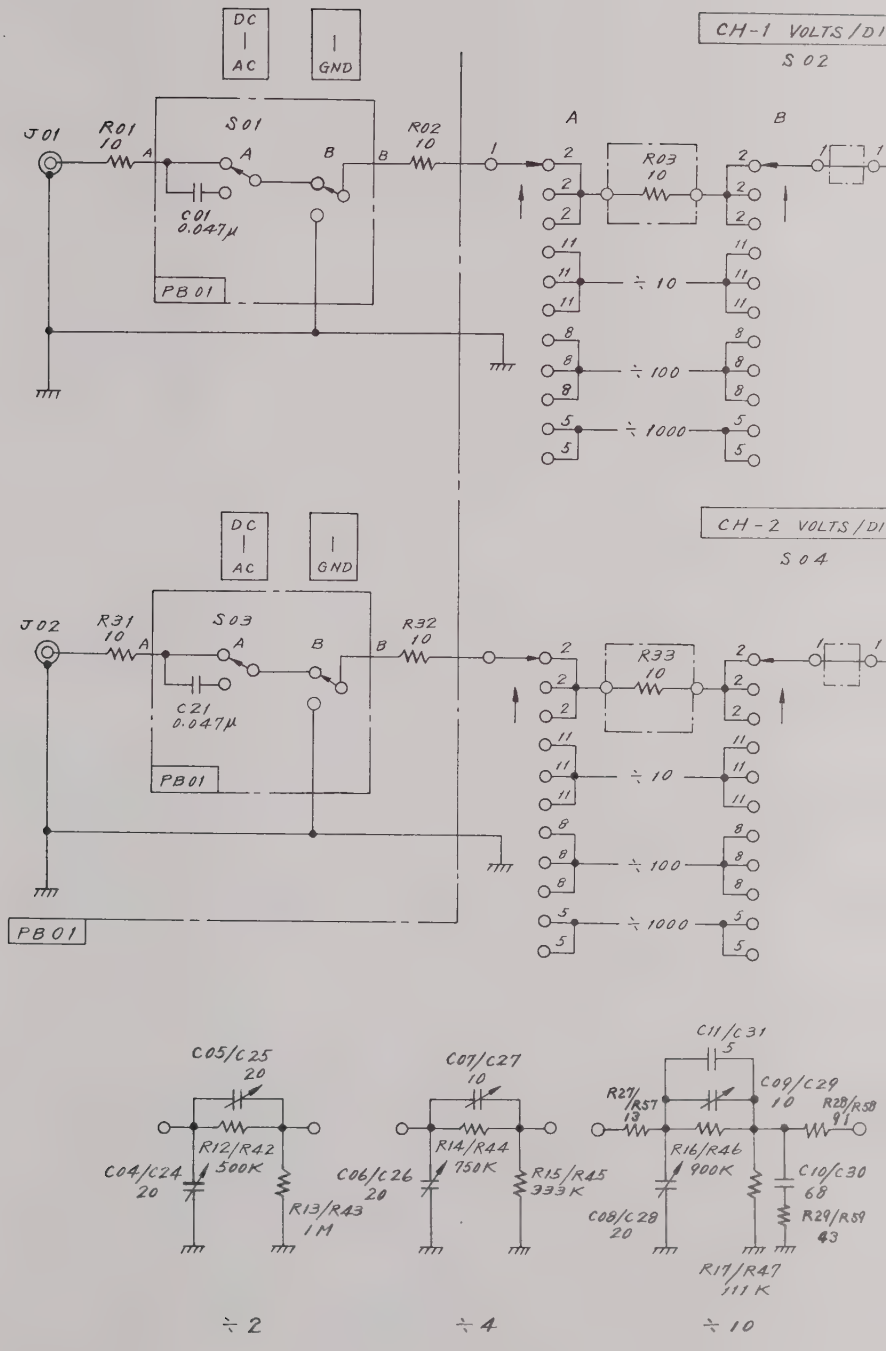


Phase difference (deg)=T (div) x40° . . . . . (3-8)

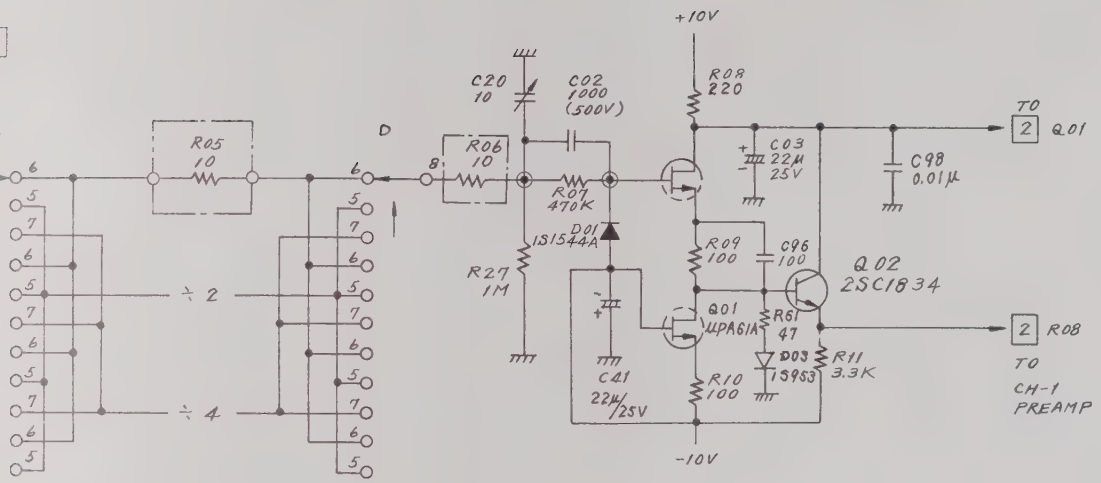
Where, T is the distance between two points at which the leading and lagging signals cross the horizontal center line of the graticule.

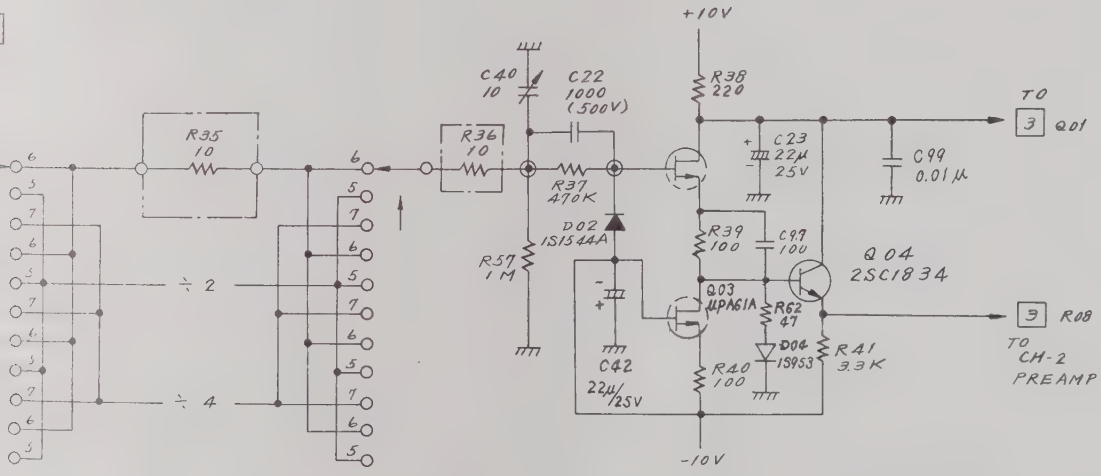
Figure 3-10. Phase difference measurement by dual-trace display

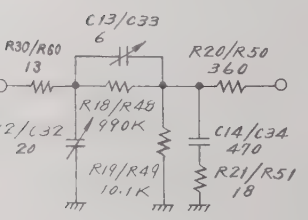


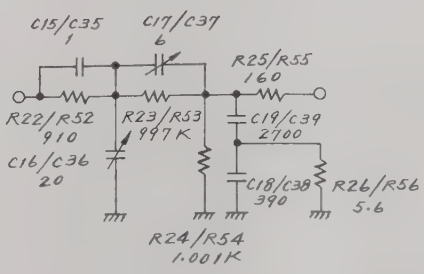

DC
AC
GND
CH-1 VOLTS/DI
S02
J01
R01
10
S01
R02
10
A
B
C01
0.047μ
PB01
R03
10
÷ 10
÷ 100
÷ 1000
CH-2 VOLTS/DI
S04
J02
R31
10
S03
R32
10
C21
0.047μ
R33
10
PB01

C05/C25
20
R12/R42
500K
C04/C24
20
R13/R43
1M
÷ 2
C07/C27
10
R14/R44
750K
C06/C26
20
R15/R45
333K
÷ 4
C11/C31
5
C09/C29
10
R28/R58
91
R27/R57
13
R16/R46
900K
C10/C30
68
C08/C28
20
R29/R59
43
R17/R47
111K
÷ 10









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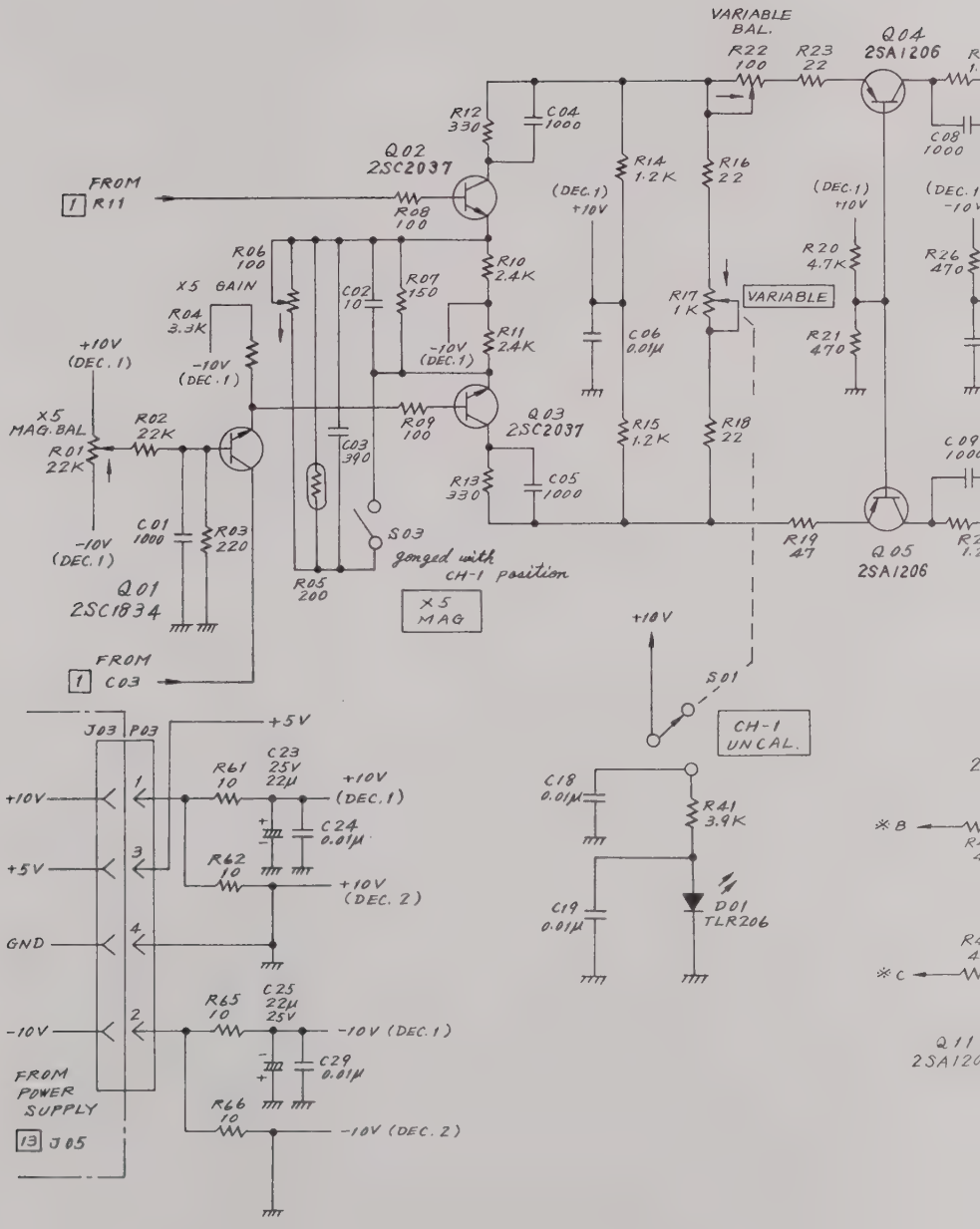
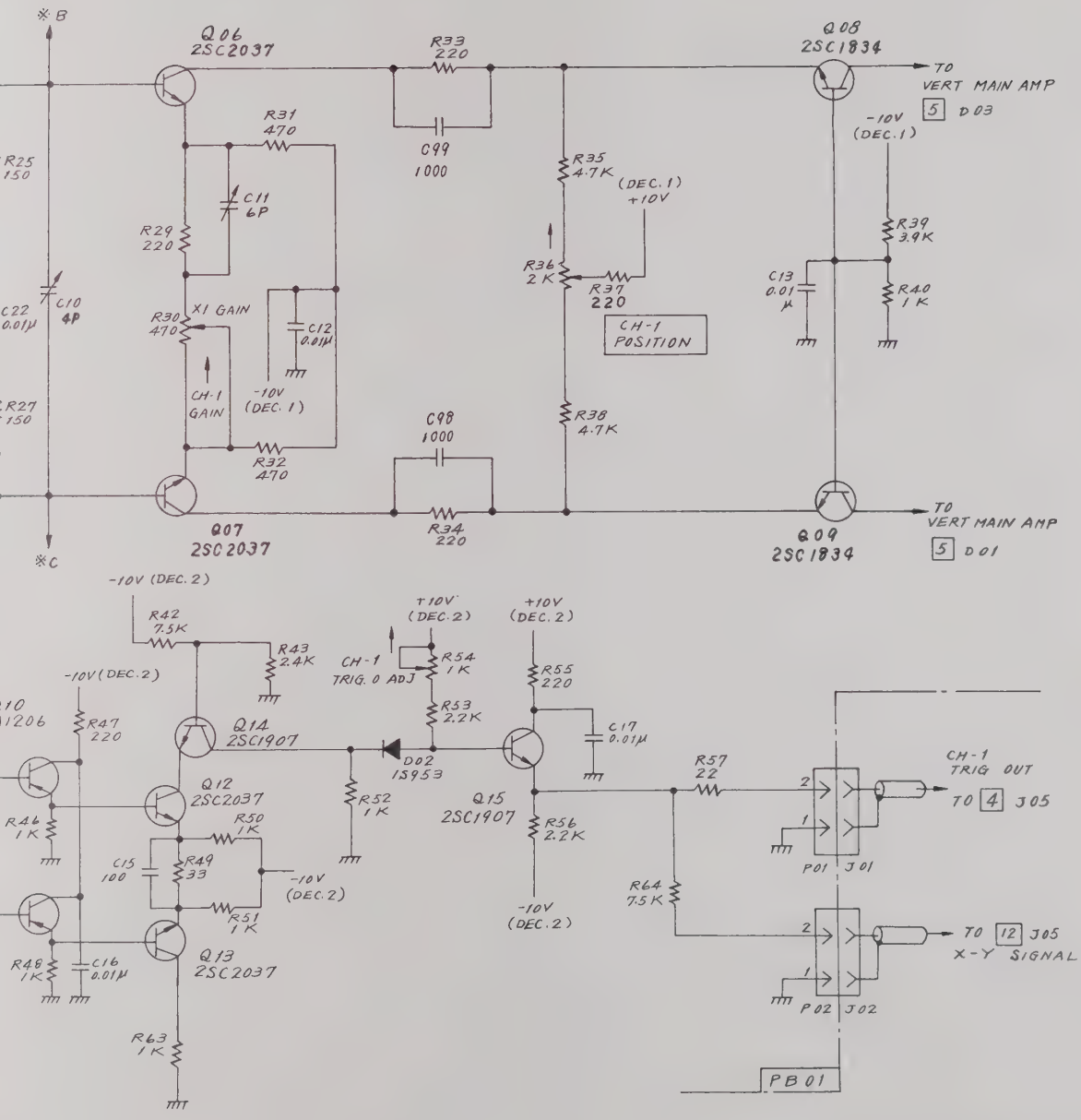
CH-1 & CH-2 ATTENUATOR 1

BBWSS24020102


VARIABLE BAL.
R22 100
R23 22
Q04 2SA1206
R12 330
C04 1000
Q02 2SC2037
FROM 1 R11
R08 100
R14 1.2K
R16 22
(DEC.1) +10V
C08 1000
R06 100
R10 2.4K
X5 GAIN
R04 3.3K
C02 10
R07 150
R17 1K
VARIABLE
R20 4.7K
R26 470
+10V (DEC.1)
-10V (DEC.1)
R11 2.4K
C06 0.01μ
R21 470
X5 MAG. BAL
R01 22K
R02 22K
R09 100
Q03 2SC2037
R15 1.2K
R18 22
C03 390
C01 1000
R03 220
S03
ganged with CH-1 position
R13 330
C05 1000
R19 47
Q05 2SA1206
R05 200
X5 MAG
Q01 2SC1834
FROM 1 C03
+10V
S01
CH-1 UNCAL.
J03 P03
+5V
C23 25V 22μ
R61 10
+10V (DEC.1)
C24 0.01μ
R62 10
+10V (DEC.2)
GND
C25 22μ 25V
R65 10
-10V (DEC.1)
C29 0.01μ
R66 10
-10V (DEC.2)
FROM POWER SUPPLY
13 J05
C18 0.01μ
R41 3.9K
C19 0.01μ
D01 TLR206
※B
※C



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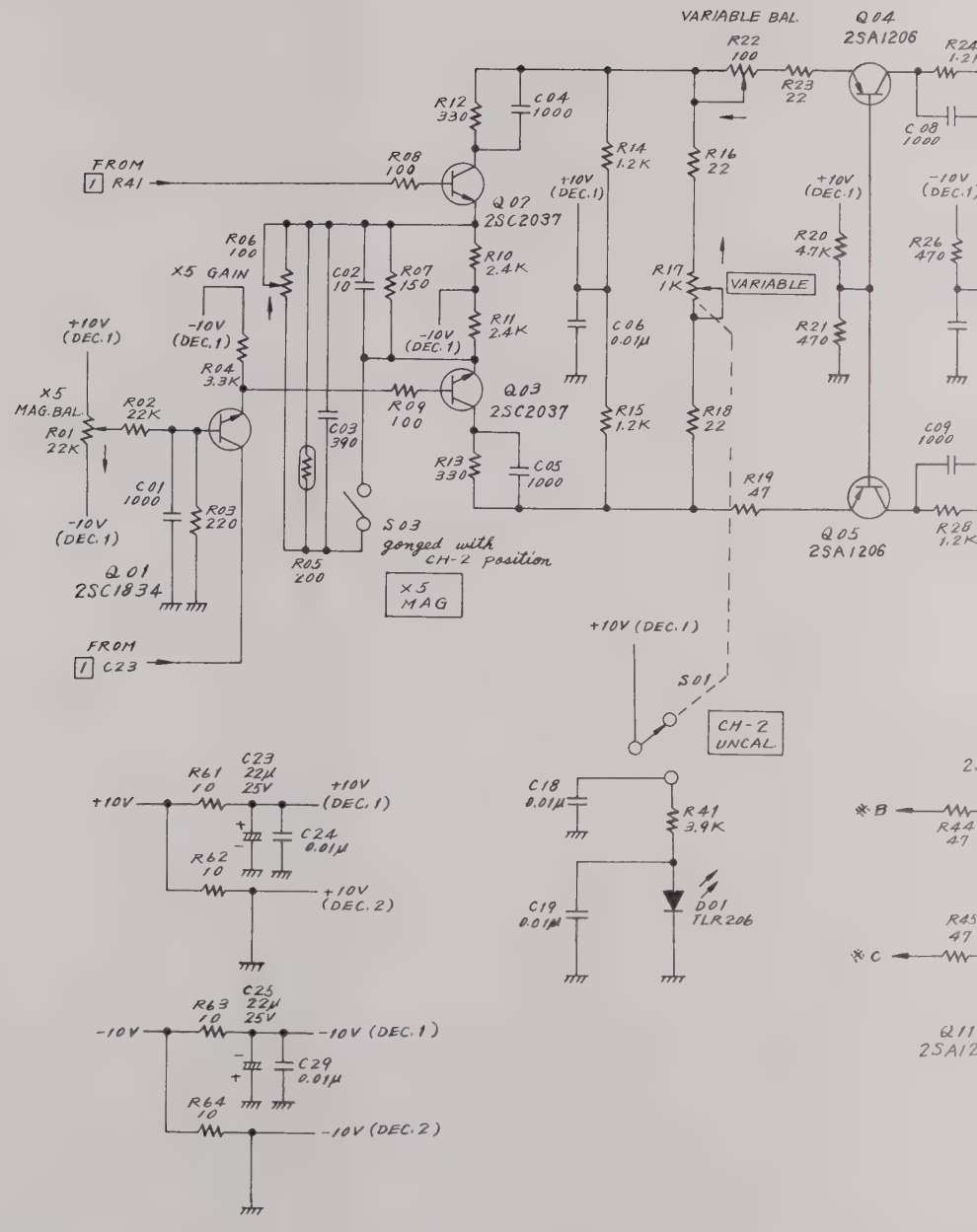
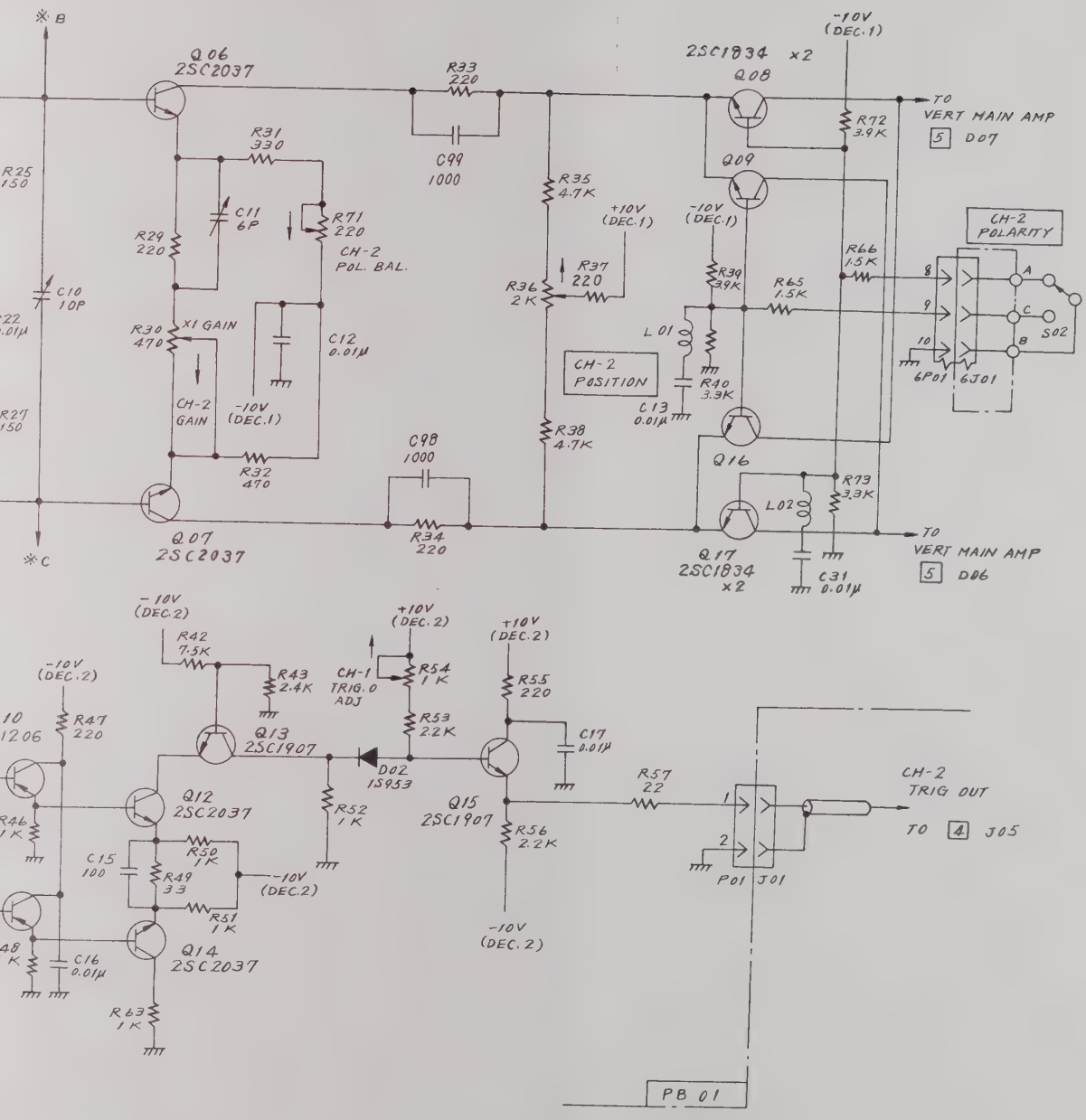
CH-1 PRE-AMPLIFIER 2

BBWSS24021102


VARIABLE BAL.
Q04
2SA1206
R22
100
R23
22
C04
1000
R12
330
R14
1.2K
R16
22
FROM
1
R41
R08
100
Q07
2SC2037
+10V
(DEC.1)
-10V
(DEC.1)
R06
100
X5 GAIN
C02
10
R07
150
R10
2.4K
R11
2.4K
R17
1K
VARIABLE
R20
4.7K
R21
470
R26
470
C06
0.01μ
+10V
(DEC.1)
-10V
(DEC.1)
R04
3.3K
X5
MAG.BAL.
R01
22K
R02
22K
R09
100
Q03
2SC2037
R15
1.2K
R18
22
C03
390
R13
330
C05
1000
C09
1000
R19
47
C01
1000
R03
220
-10V
(DEC.1)
Q01
2SC1834
R05
200
S03
ganged with
CH-2 position
X5
MAG
Q05
2SA1206
R28
1.2K
FROM
1
C23
+10V (DEC.1)
S01
CH-2
UNCAL.
C23
22μ
25V
R61
10
+10V
+10V
(DEC.1)
C24
0.01μ
R62
10
+10V
(DEC.2)
C18
0.01μ
R41
3.9K
C19
0.01μ
D01
TLR206
*B
R44
47
*C
C25
22μ
25V
R63
10
-10V
-10V (DEC.1)
C29
0.01μ
R64
10
-10V (DEC.2)



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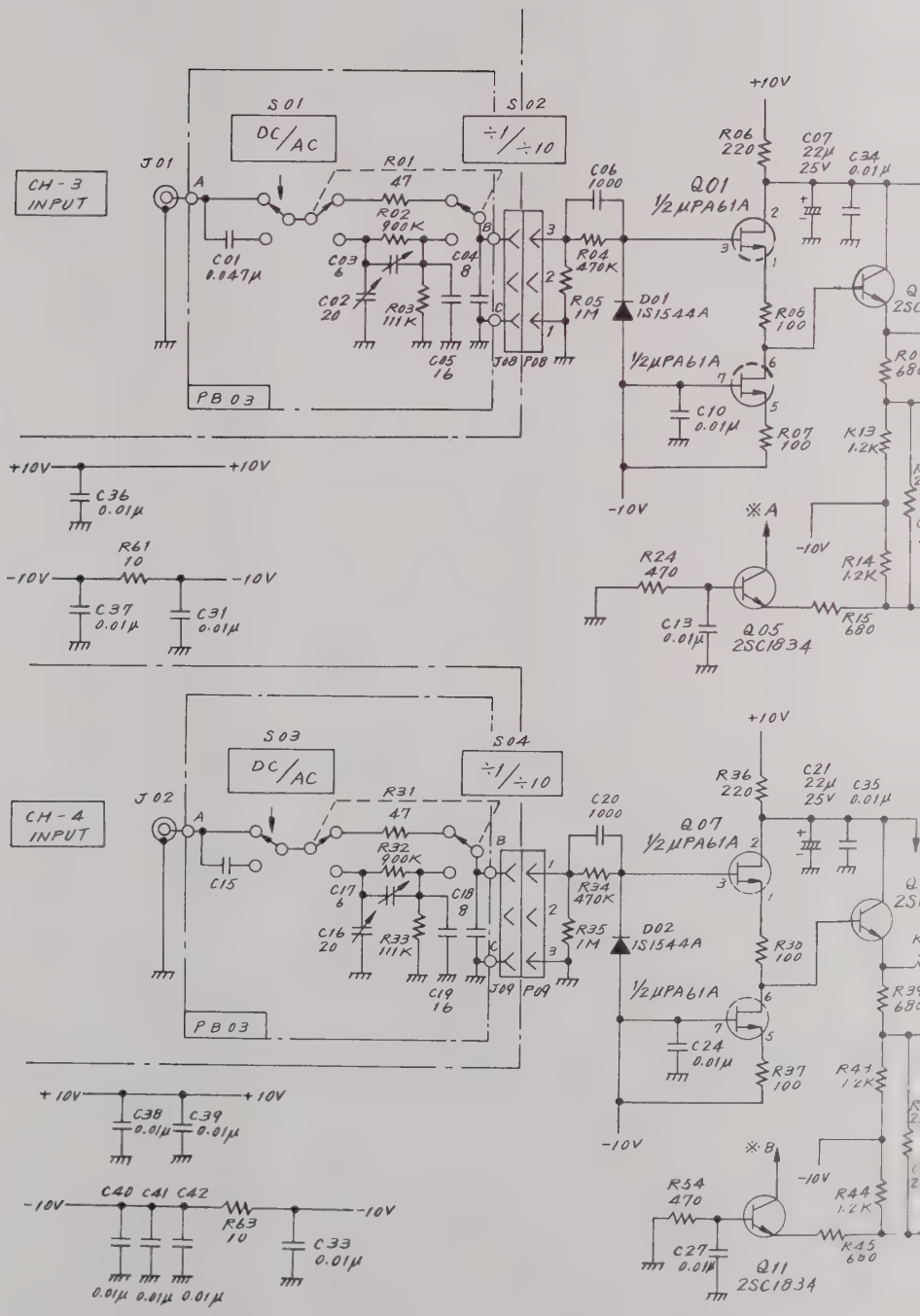
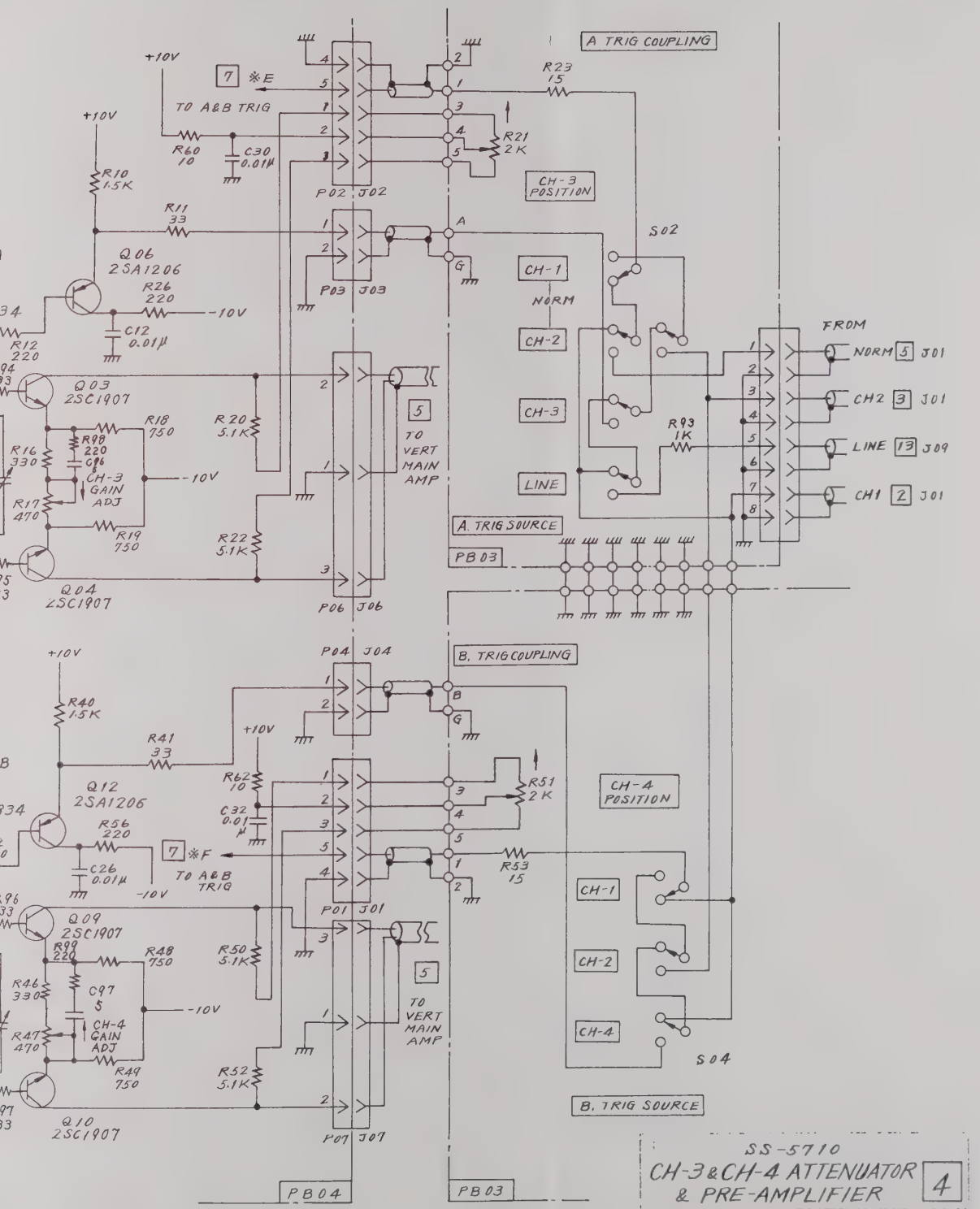
CH-2 PRE-AMPLIFIER 3

BBWSS24022102


CH-3 INPUT
J01
S01
DC/AC
S02
÷1/÷10
R01 47
R02 900K
C01 0.047μ
C03 6
C04 8
C02 20
R03 111K
C05 16
C06 1000
R04 470K
R05 1M
D01 1S1544A
PB03
J08
P08
+10V
R06 220
C07 22μ 25V
C34 0.01μ
Q01 ½μPA61A
R06 100
½μPA61A
C10 0.01μ
R07 100
R13 1.2K
-10V
※A
R24 470
C13 0.01μ
Q05 2SC1834
R14 1.2K
R15 680
+10V
C36 0.01μ
-10V
R61 10
C37 0.01μ
C31 0.01μ
CH-4 INPUT
J02
S03
DC/AC
S04
÷1/÷10
R31 47
R32 900K
C15
C17 6
C18 8
C16 20
R33 111K
C19 16
C20 1000
R34 470K
R35 1M
D02 1S1544A
PB03
J09
P09
R36 220
C21 22μ 25V
C35 0.01μ
Q07 ½μPA61A
R30 100
½μPA61A
C24 0.01μ
R37 100
R41 1.2K
-10V
※B
R54 470
C27 0.01μ
Q11 2SC1834
R44 1.2K
R45 680
+10V
C38 0.01μ
C39 0.01μ
-10V
C40 C41 C42
R63 10
C33 0.01μ
0.01μ 0.01μ 0.01μ



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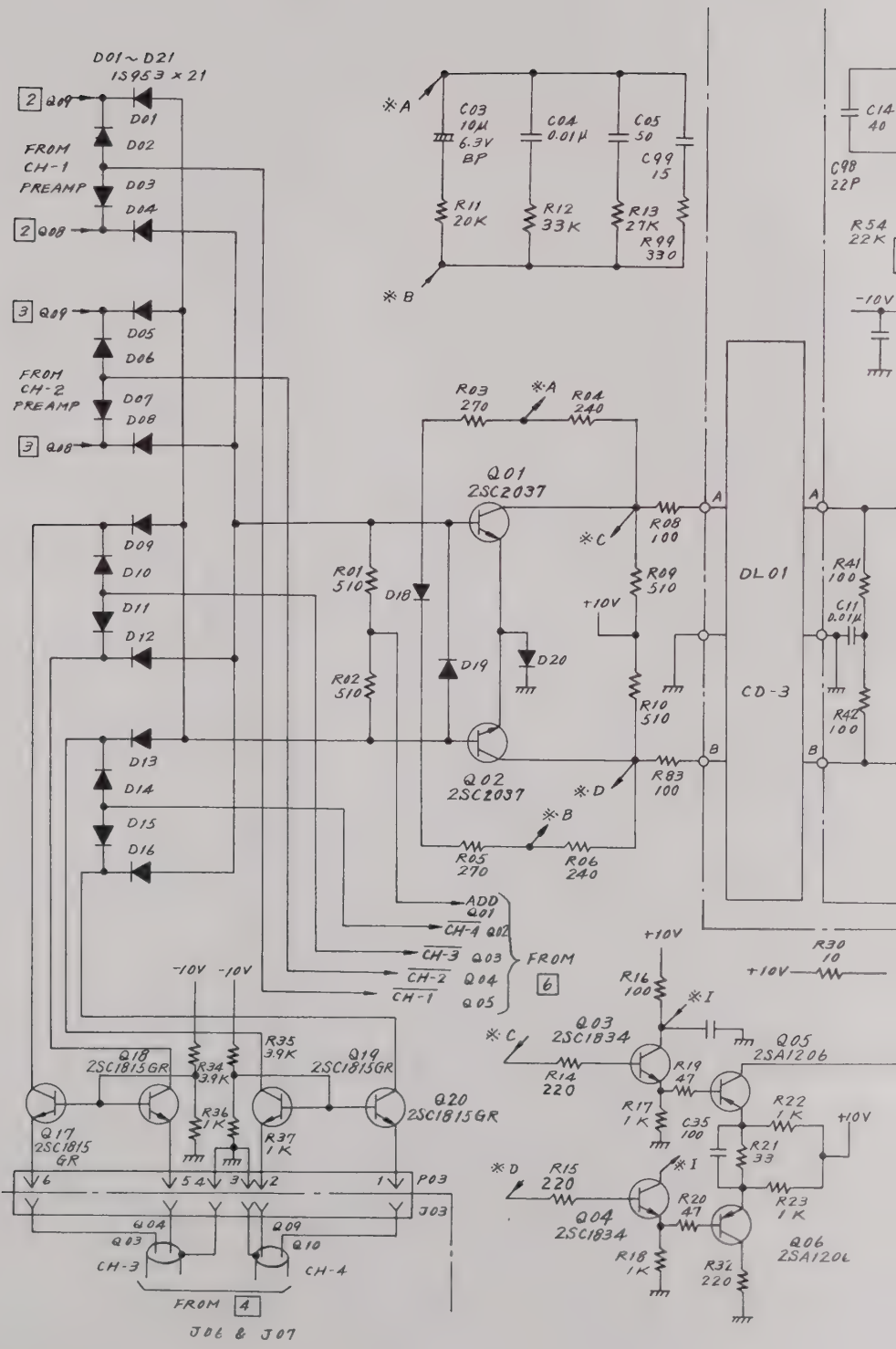
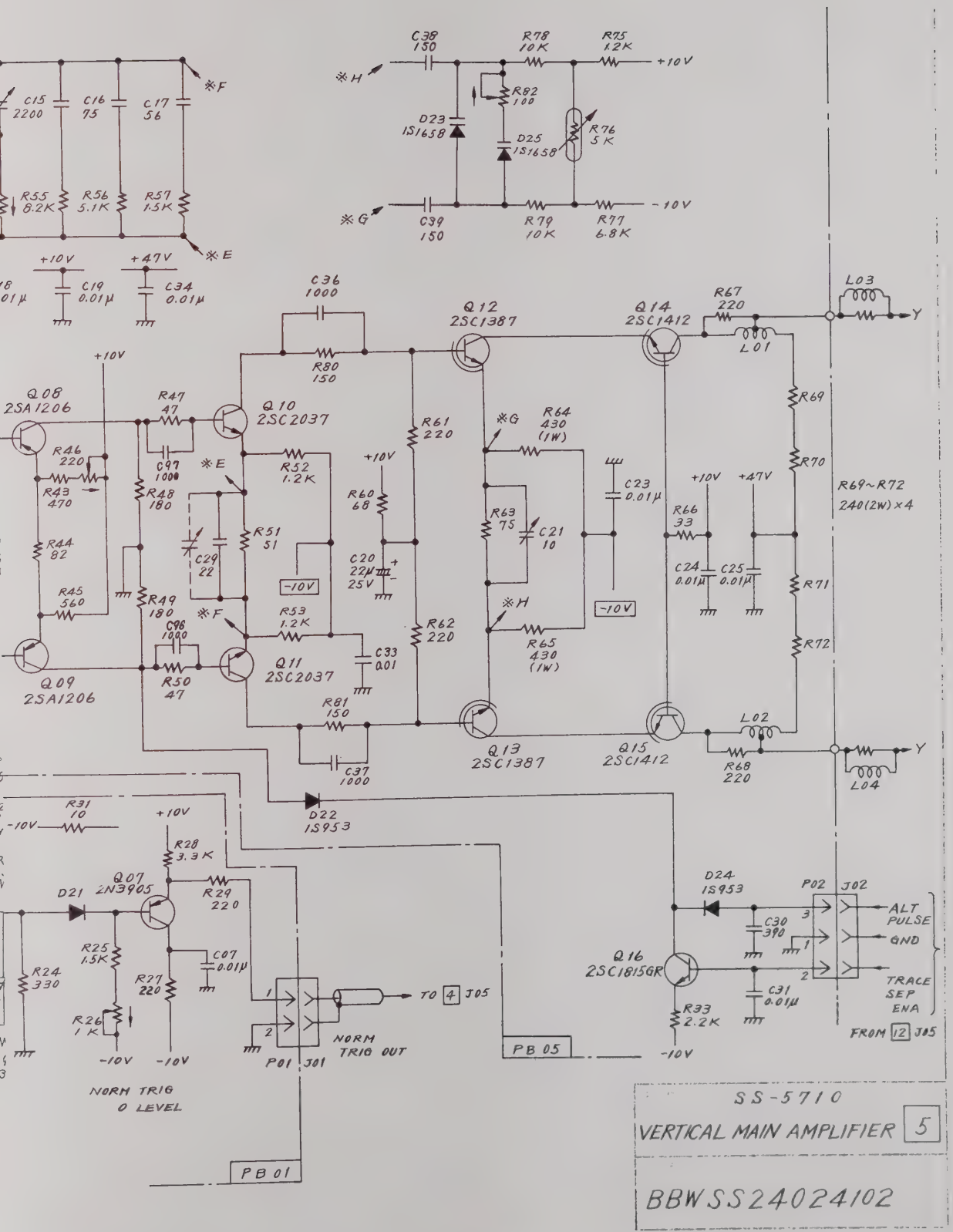
CH-3&CH-4 ATTENUATOR & PRE-AMPLIFIER 4

BBWSS24023102


D01~D21
1S953×21
2 Q09
D01
D02
FROM CH-1 PREAMP
D03
D04
2 Q08
3 Q09
D05
D06
FROM CH-2 PREAMP
D07
D08
3 Q08
D09
D10
D11
D12
D13
D14
D15
D16
※A
※B
C03 10μ 6.3V BP
C04 0.01μ
C05 50
C99 15
R11 20K
R12 33K
R13 27K
R99 330
C14 40
C98 22P
R54 22K
-10V
R03 270
R04 240
Q01 2SC2037
※C
R08 100
R01 510
D18
R09 510
+10V
D19
D20
R02 510
R10 510
Q02 2SC2037
※D
R83 100
R05 270
R06 240
DL01
CD-3
A
B
R41 100
C11 0.01μ
R42 100
ADD
Q01
CH-4 Q02
CH-3 Q03
CH-2 Q04
CH-1 Q05
FROM 6
-10V -10V
Q18 2SC1815GR
Q19 2SC1815GR
Q20 2SC1815GR
Q17 2SC1815 GR
R34 3.9K
R35 3.9K
R36 1K
R37 1K
6 5 4 3 2 1 P03
J03
Q04 Q03 CH-3
Q09 Q10 CH-4
FROM 4
J06 & J07
+10V
R16 100
※I
Q03 2SC1834
Q05 2SA1206
R14 220
R19 47
R17 1K
C35 100
R22 1K
R21 33
R23 1K
※D
R15 220
R20 47
Q04 2SC1834
Q06 2SA1206
R18 1K
R31 220
R30 10



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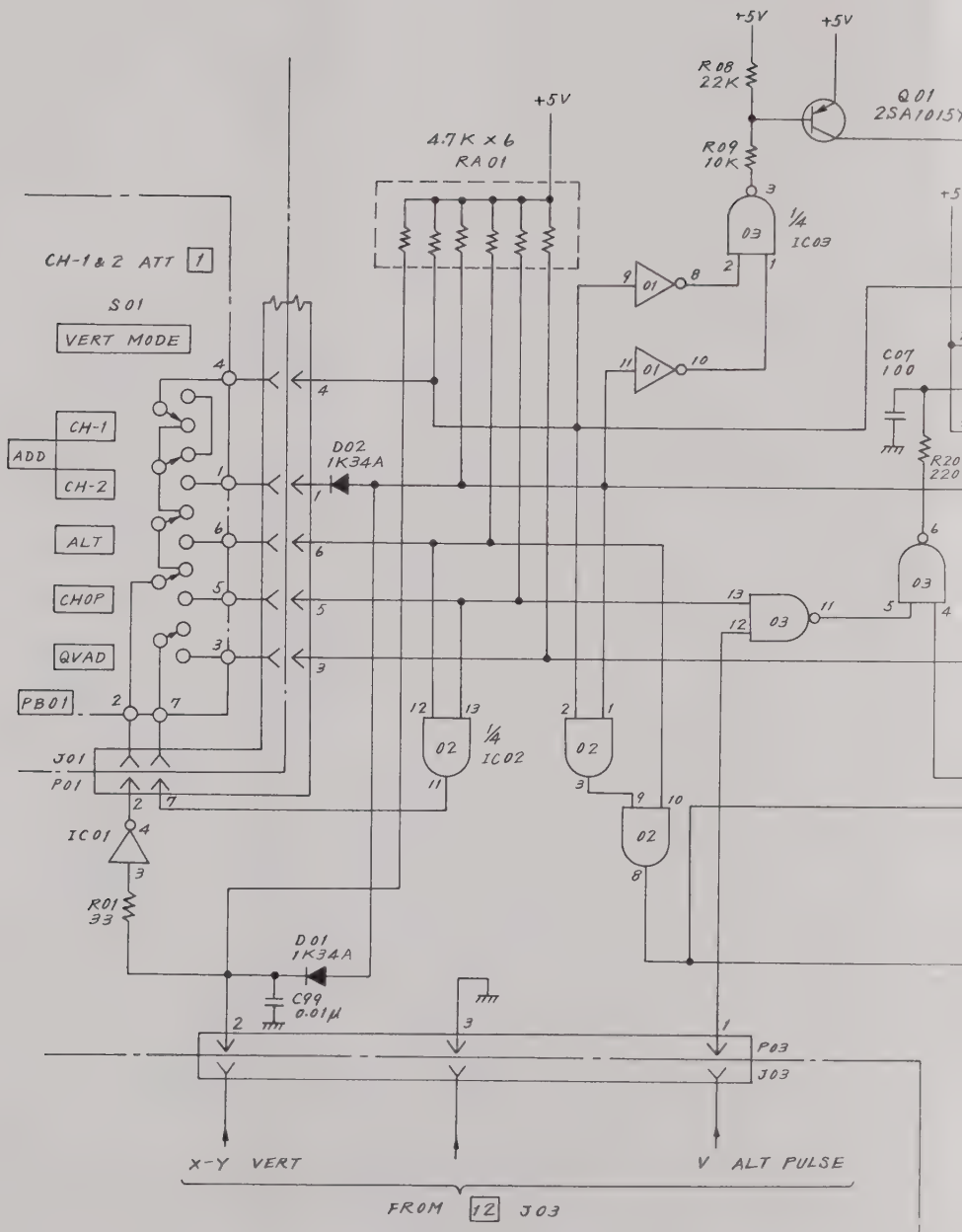
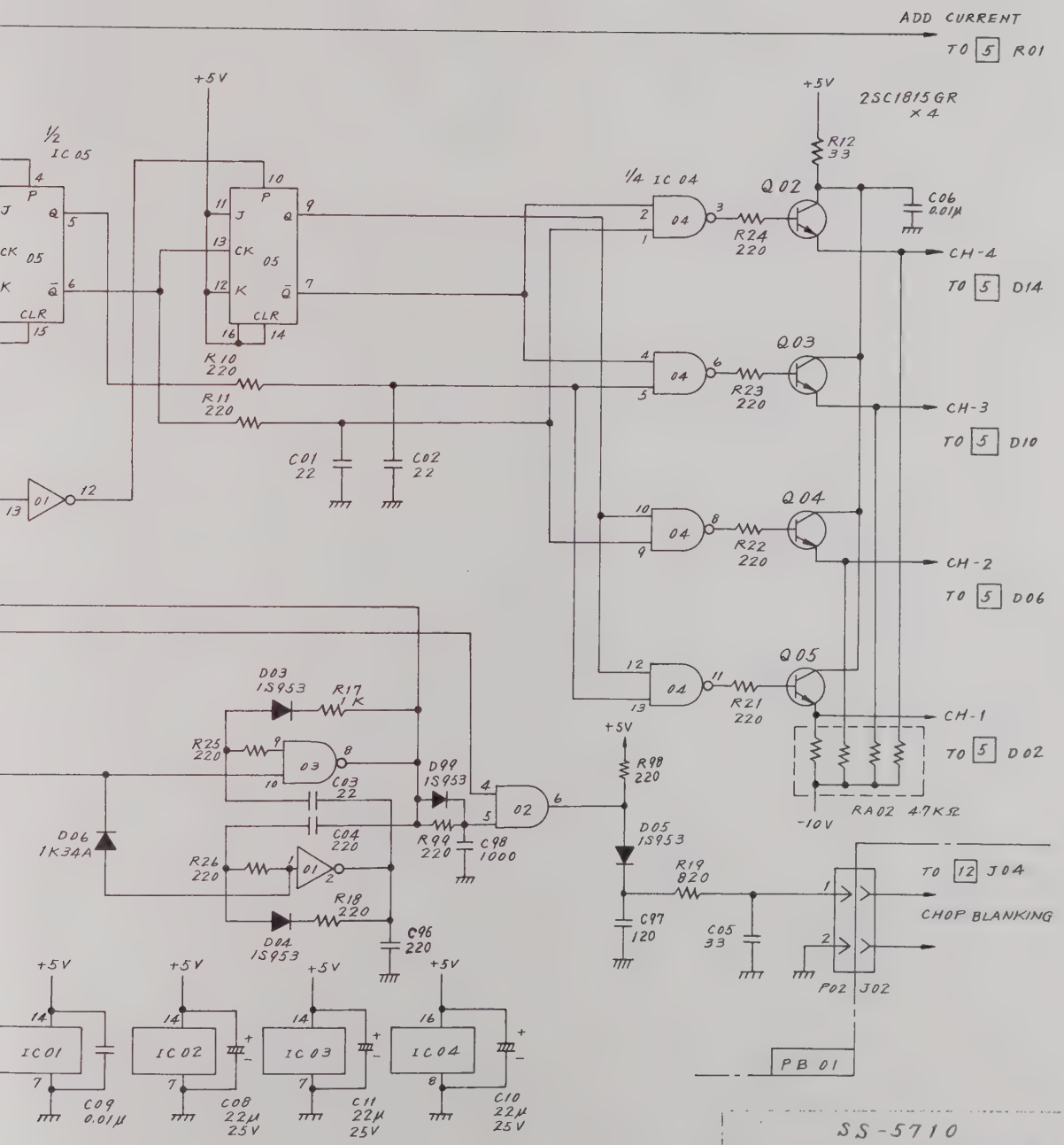
VERTICAL MAIN AMPLIFIER 5

BBWSS24024102


+5V
+5V
R08 22K
Q01 2SA1015Y
4.7K x 6 RA01
+5V
R09 10K
1/4 IC03
CH-1&2 ATT 1
S01
VERT MODE
CH-1
ADD
CH-2
ALT
CHOP
QVAD
PB01
J01
P01
IC01
R01 33
D02 1K34A
D01 1K34A
C99 0.01μ
1/4 IC02
C07 100
R20 220
P03
J03
X-Y VERT
V ALT PULSE
FROM 12 J03
IC 01 74LS04N
IC 02 74LS08N
IC 03 74LS00N
04
IC 05 74LS112N



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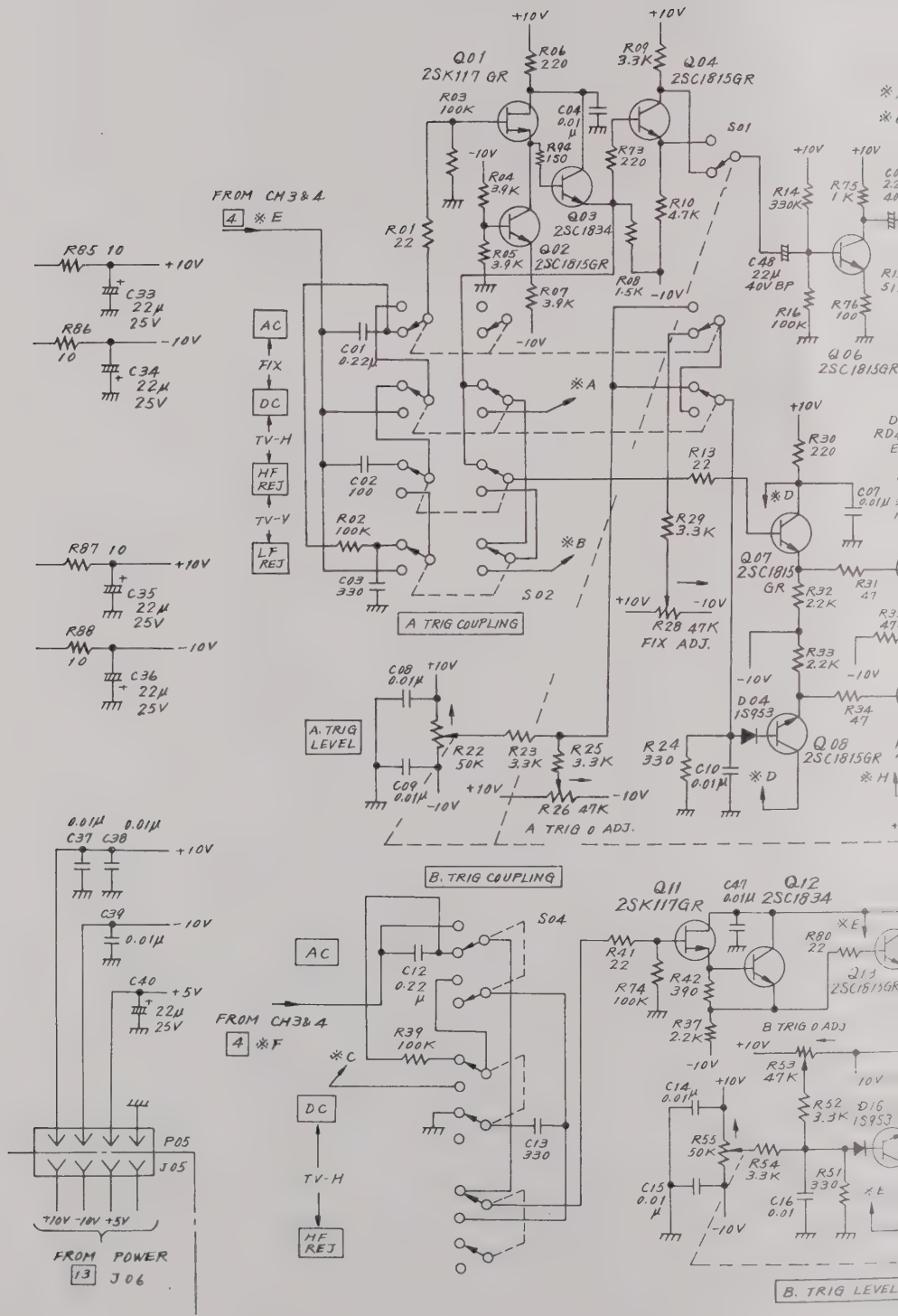
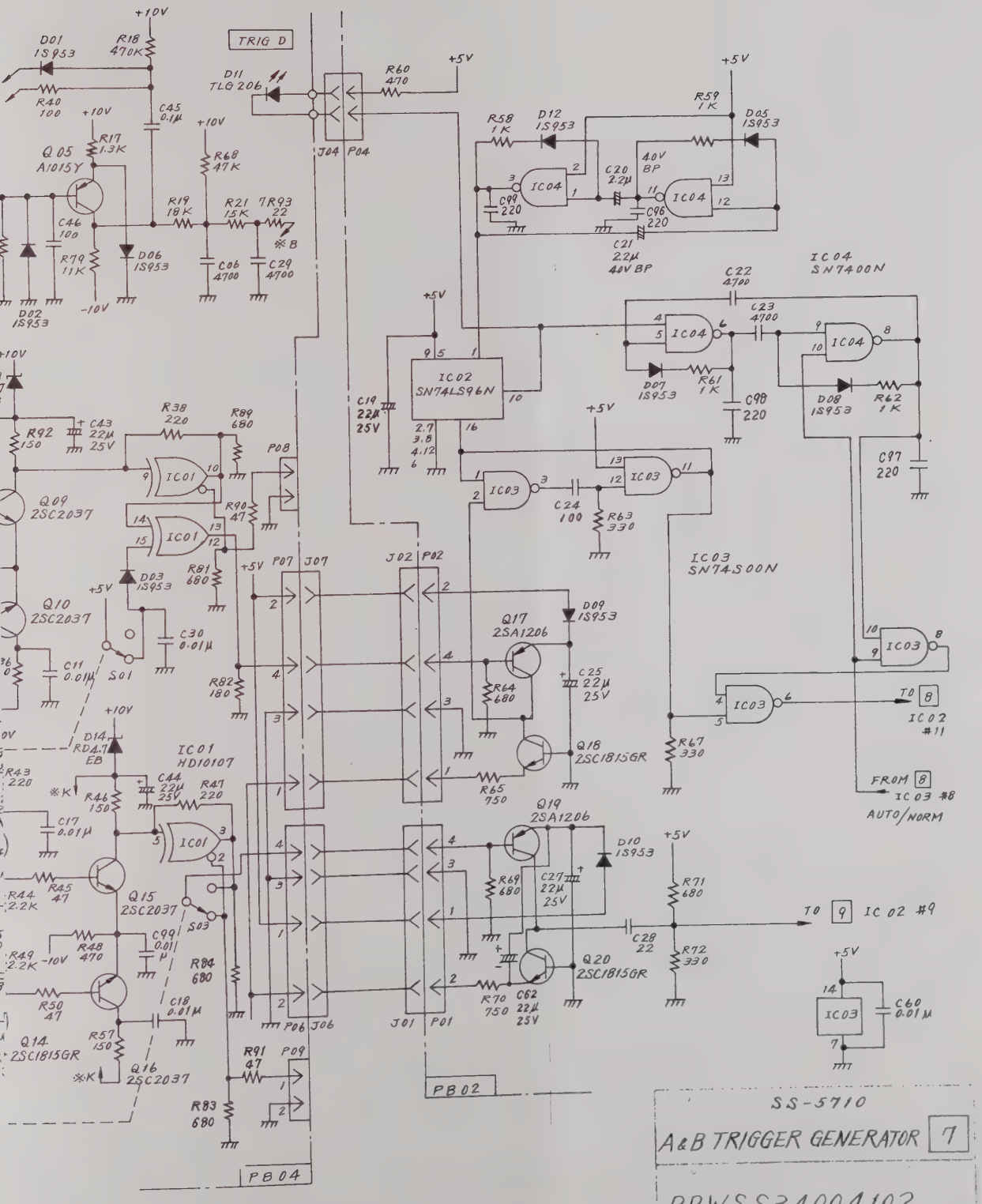
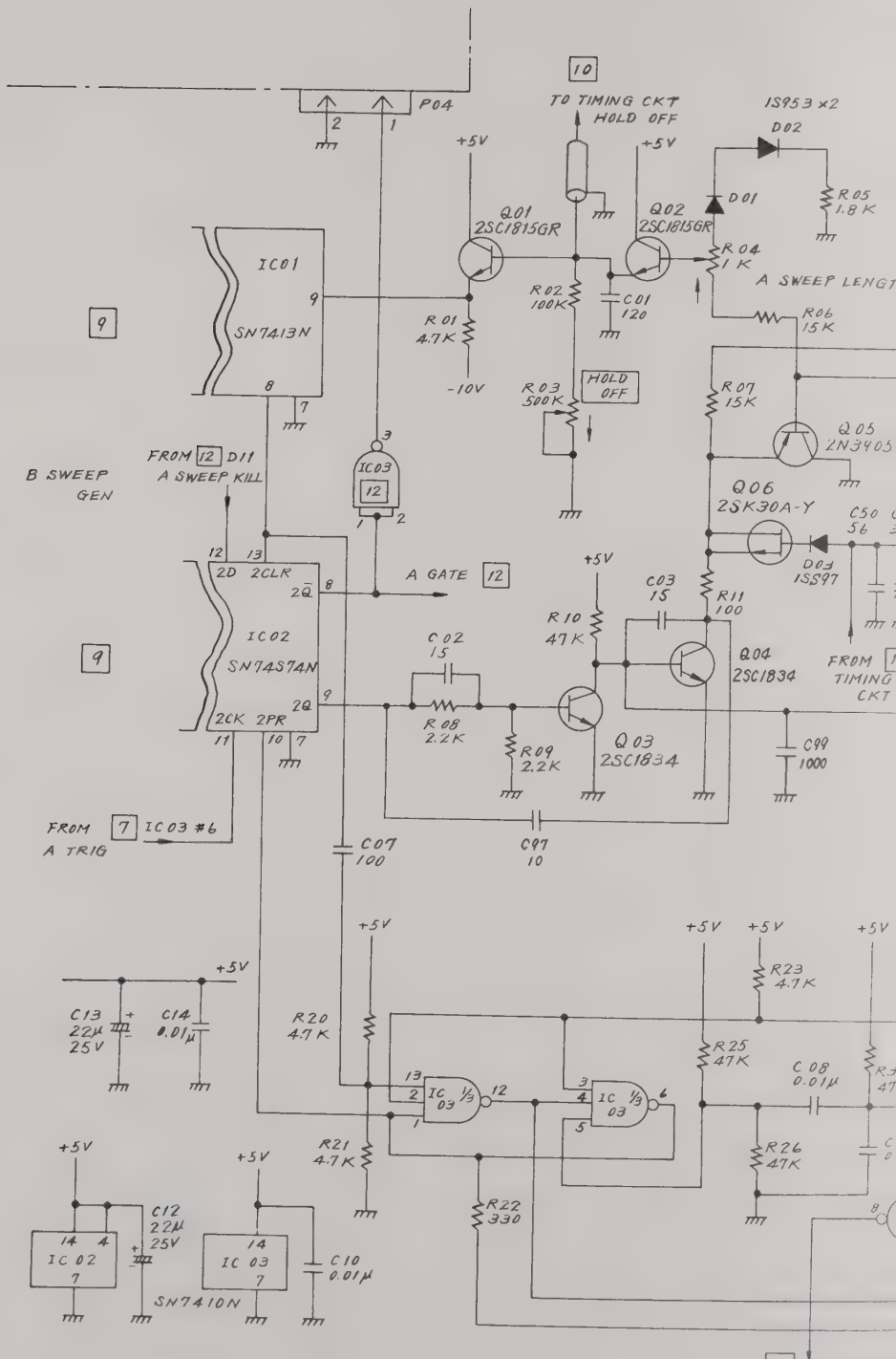
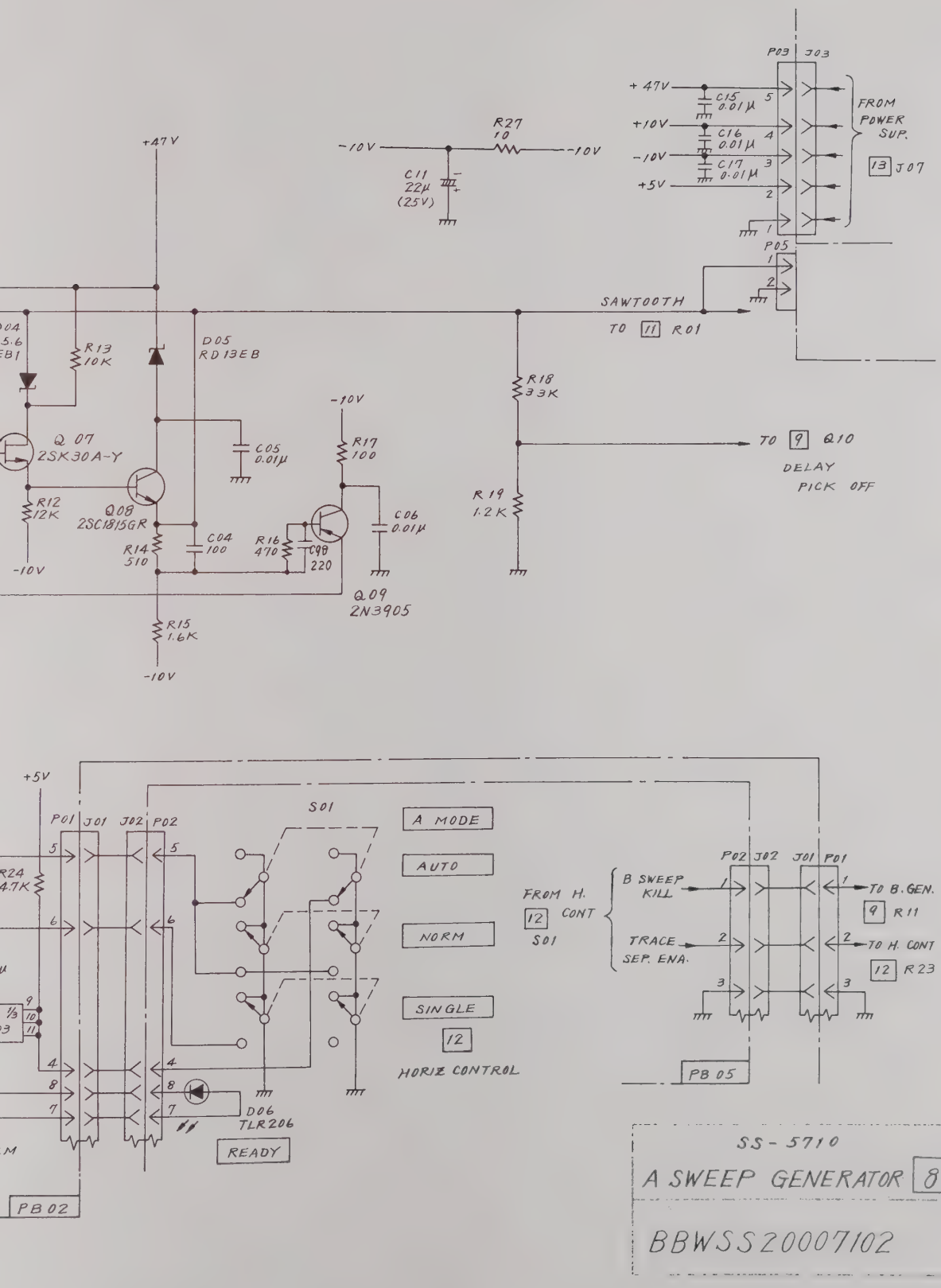
VERTICAL CONTROL 6

BBWSS10004102


Q01 2SK117 GR
Q02 2SC1815GR
Q03 2SC1834
Q04 2SC1815GR
Q06 2SC1815GR
Q07 2SC1815 GR
Q08 2SC1815GR
Q11 2SK117GR
Q12 2SC1834
Q13 2SC1815GR
D04 1S953
D16 1S953
S01
S02
S04
A TRIG COUPLING
A TRIG LEVEL
A TRIG 0 ADJ.
R28 47K FIX ADJ.
B. TRIG COUPLING
B TRIG 0 ADJ
B. TRIG LEVEL
FROM CH3&4
FROM POWER
13 J06
P05
J05
AC
DC
FIX
TV-H
TV-V
HF REJ
LF REJ
+10V
-10V
+5V


TRIG D
D01 1S953
R18 470K
+10V
R40 100
C45 0.1μ
Q05 A1015Y
R17 1.3K
R68 47K
R19 18K
R21 15K
TR93 22
※B
C46 100
R79 11K
D06 1S953
C06 4700
C29 4700
D02 1S953
-10V
D11 TLG206
R60 470
+5V
J04 P04
R58 1K
D12 1S953
R59 1K
D05 1S953
IC04
C20 2.2μ
40V BP
C99 220
C96 220
C21 2.2μ 40V BP
IC04 SN7400N
C22 4700
C23 4700
D07 1S953
R61 1K
C98 220
D08 1S953
R62 1K
C97 220
IC02 SN74LS96N
C19 22μ 25V
2.7 3.8 4.12
R38 220
R89 680
C43 22μ 25V
R92 150
P08
IC01
R90 47
Q09 2SC2037
D03 1S953
R81 680
Q10 2SC2037
S01
C30 0.01μ
C11 0.01μ
IC03
C24 100
R63 330
IC03 SN74S00N
P07 J07
J02 P02
D09 1S953
Q17 2SA1206
C25 22μ 25V
R64 680
R82 180
Q18 2SC1815GR
R65 750
R67 330
TO 8 IC02 #11
FROM 8 IC03 #8 AUTO/NORM
D14 RD4.7 EB
IC01 HD10107
C44 22μ 25V
R47 220
R46 150
※K
C17 0.01μ
R43 220
R45 47
R44 2.2K
Q15 2SC2037
S03
C99 0.01μ
R48 470
R49 2.2K
R84 680
C18 0.01μ
R50 47
Q14 2SC1815GR
R57 150
Q16 2SC2037
R83 680
R91 47
P09
P06 J06
J01 P01
Q19 2SA1206
D10 1S953
R69 680
C27 22μ 25V
R71 680
C28 22
R72 330
Q20 2SC1815GR
R70 750
C62 22μ 25V
TO 9 IC02 #9
C60 0.01μ
PB02
PB04
SS-5710
A&B TRIGGER GENERATOR 7
BBWSS34004102


P04
10
TO TIMING CKT HOLD OFF
1S953 ×2
D02
D01
+5V
Q01 2SC1815GR
Q02 2SC1815GR
R05 1.8K
R04 1K
A SWEEP LENGT
IC01 SN7413N
R02 100K
C01 120
R06 15K
R01 4.7K
-10V
R03 500K
HOLD OFF
R07 15K
Q05 2N3905
FROM 12 D11 A SWEEP KILL
B SWEEP GEN
IC03 12
Q06 2SK30A-Y
C50 56
D03 1SS97
A GATE 12
IC02 SN74S74N
2D 2CLR 2Q 2CK 2PR
C03 15
R11 100
R10 47K
C02 15
R08 2.2K
R09 2.2K
Q03 2SC1834
Q04 2SC1834
C99 1000
FROM TIMING CKT
FROM 7 IC03 #6 A TRIG
C07 100
C97 10
C13 22μ 25V
C14 0.01μ
R20 4.7K
R23 4.7K
R25 47K
C08 0.01μ
IC03 1/3
R21 4.7K
R26 47K
R22 330
C12 22μ 25V
IC02
IC03
C10 0.01μ
SN7410N
7 AUTO/-



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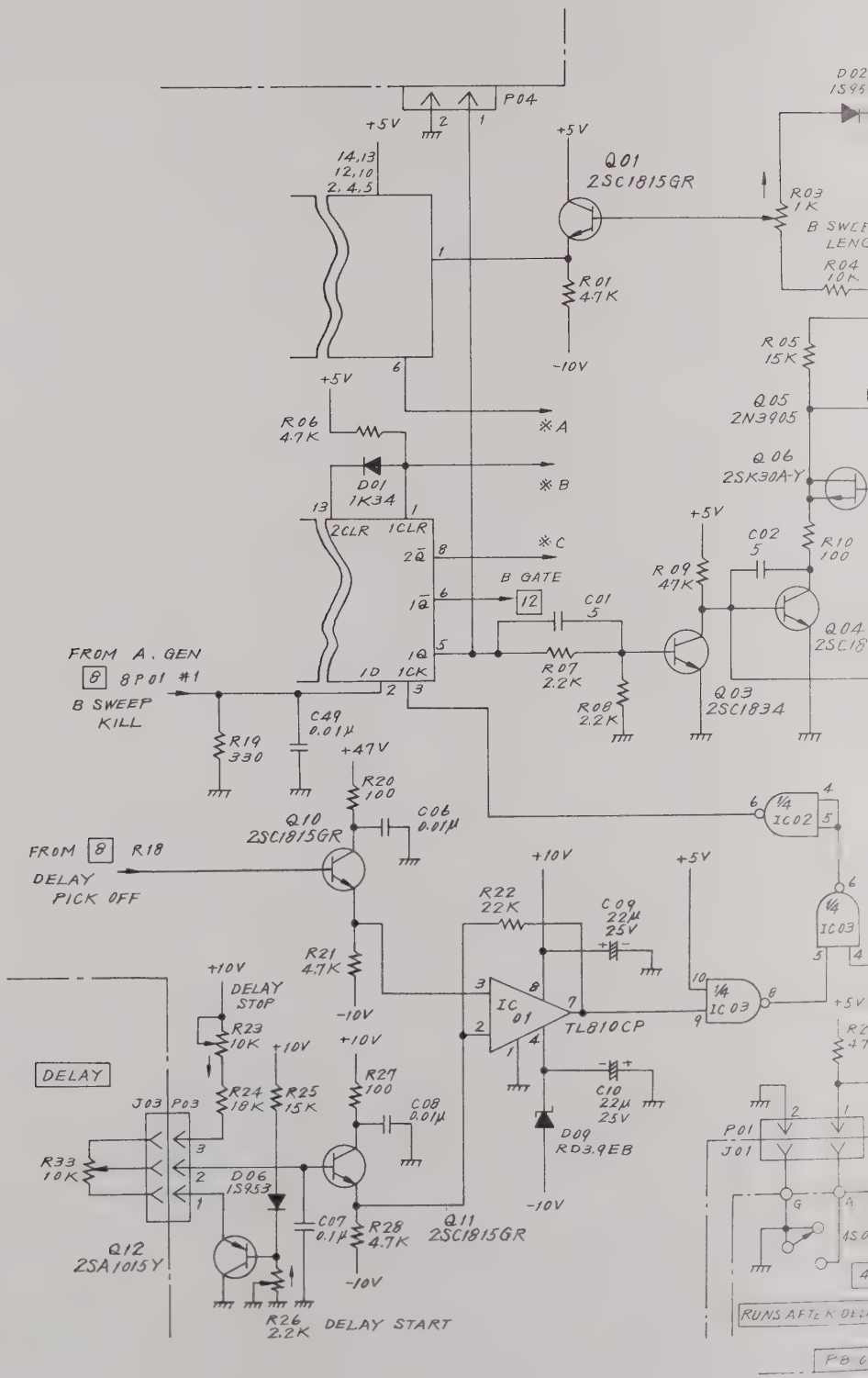
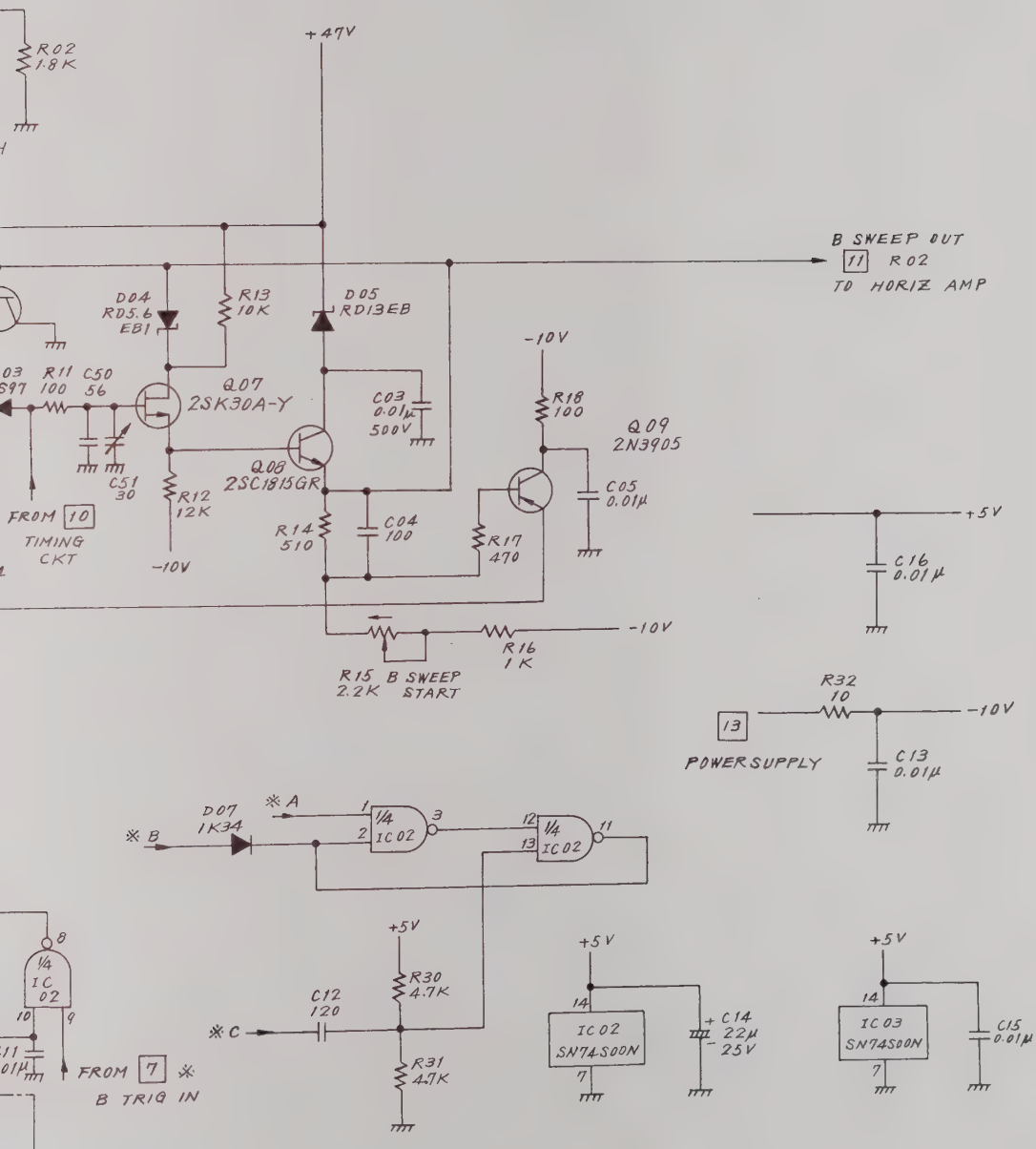
A SWEEP GENERATOR 8

BBWSS20007102


P04
+5V
14,13
12,10
2,4,5
Q01
2SC1815GR
R03
1K
R01
4.7K
-10V
R05
15K
Q05
2N3905
Q06
2SK30A-Y
R06
4.7K
※A
※B
※C
D01
1K34
2CLR
1CLR
2Q̄
1Q̄
1Q
1D
1CK
B GATE
12
C01
5
R07
2.2K
R08
2.2K
R09
47K
C02
5
R10
100
Q03
2SC1834
FROM A. GEN
8
8P01 #1
B SWEEP
KILL
R19
330
C49
0.01μ
+47V
R20
100
Q10
2SC1815GR
C06
0.01μ
FROM 8 R18
DELAY
PICK OFF
R21
4.7K
+10V
DELAY
STOP
R23
10K
R22
22K
C09
22μ
25V
IC
01
TL810CP
C10
22μ
25V
D09
RD3.9EB
DELAY
J03 P03
R24
18K
R25
15K
R27
100
C08
0.01μ
R33
10K
D06
1S953
C07
0.1μ
R28
4.7K
Q11
2SC1815GR
Q12
2SA1015Y
R26
2.2K
DELAY START
1/4
IC02
1/4
IC03
P01
J01
RUNS AFTER DEL



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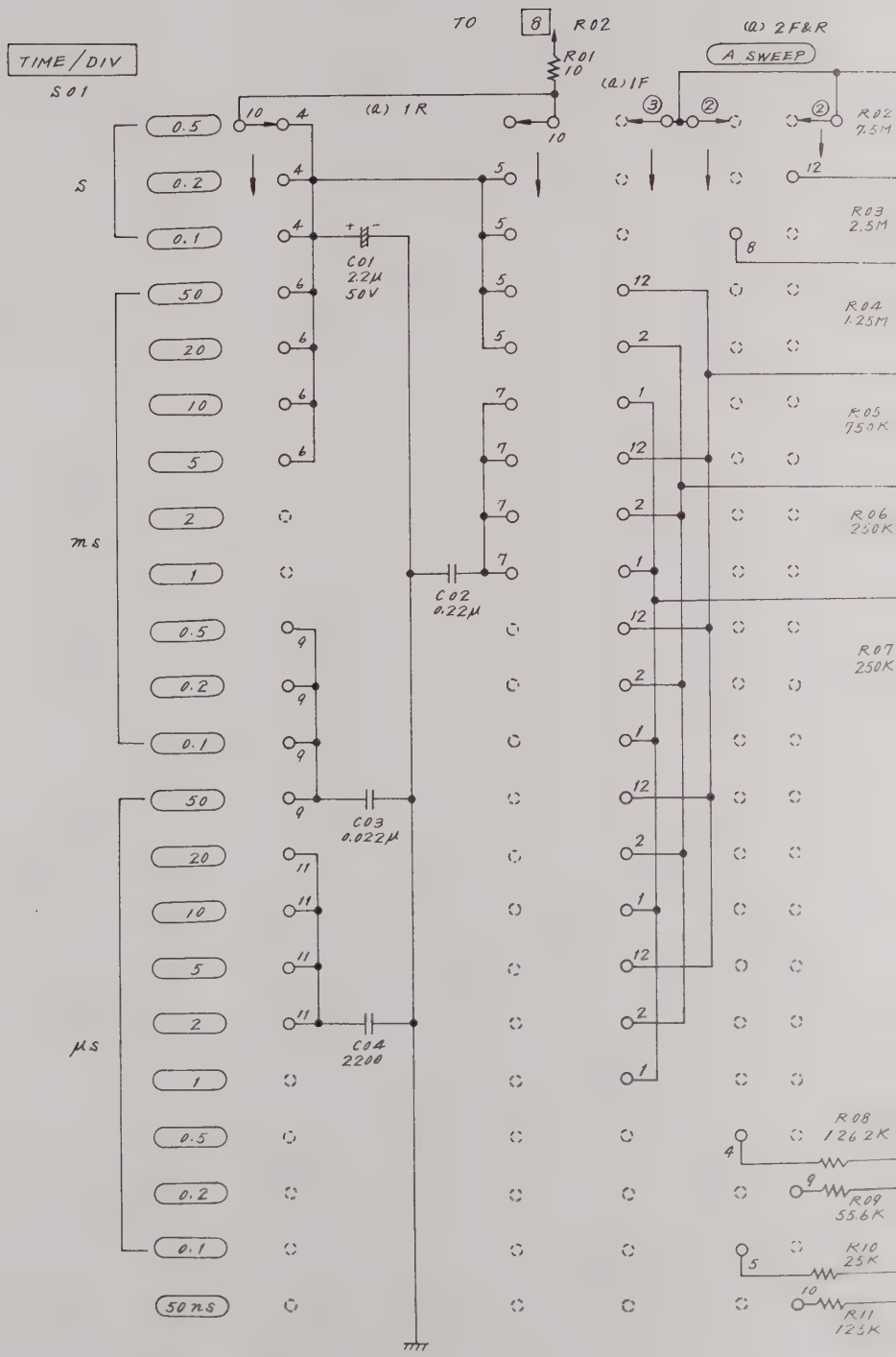
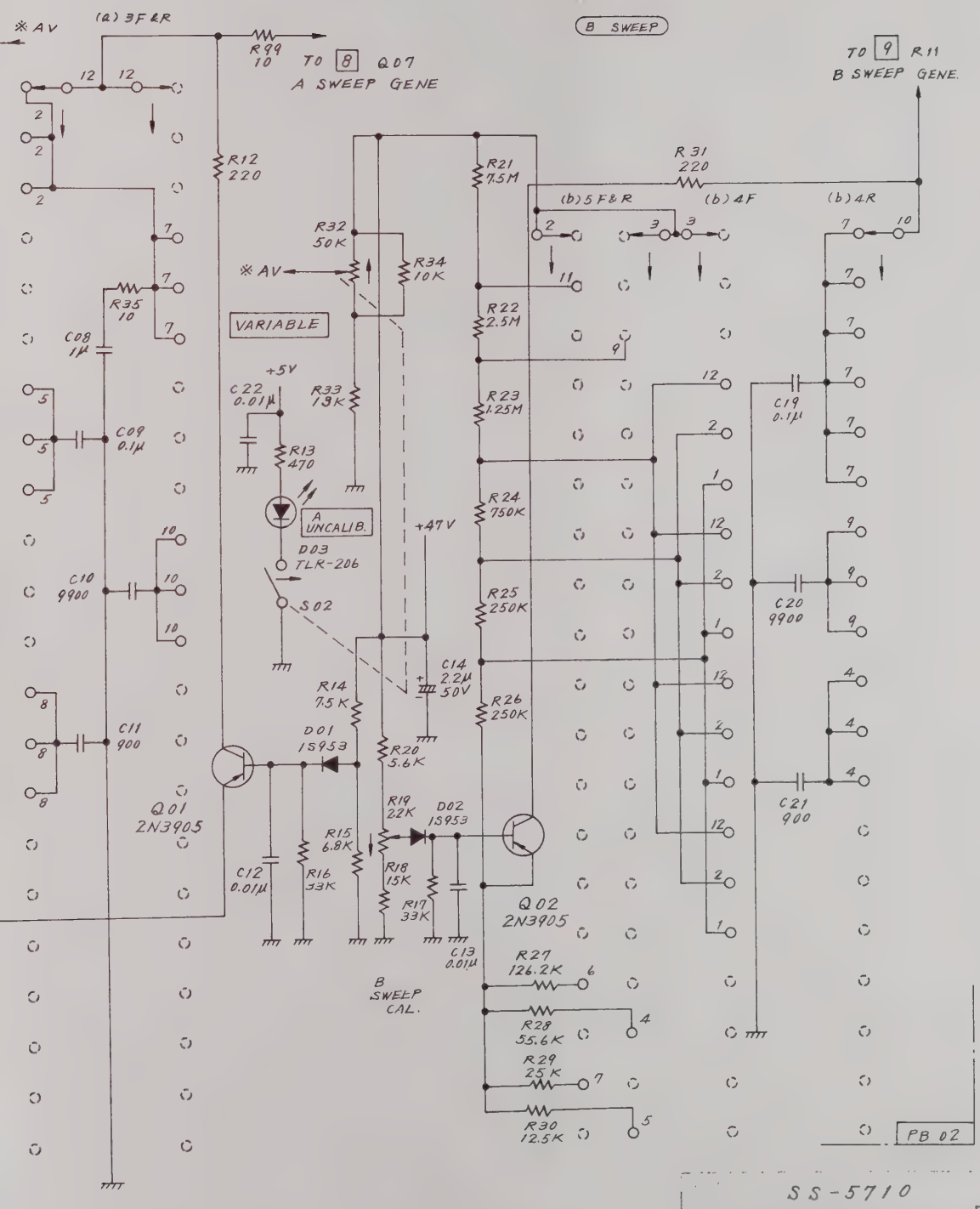
B SWEEP GENERATOR 9

BBWSS20008102


TIME/DIV
S01
TO
8
R02
R01
10
(a) 1R
(a) 1F
(a) 2F&R
A SWEEP
0.5
0.2
0.1
50
20
10
5
2
1
0.5
0.2
0.1
50
20
10
5
2
1
0.5
0.2
0.1
50ns
S
ms
μs
C01
2.2μ
50V
C02
0.22μ
C03
0.022μ
C04
2200
R02
7.5M
R03
2.5M
R04
1.25M
R05
750K
R06
250K
R07
250K
R08
126.2K
R09
55.6K
R10
25K
R11
12.5K



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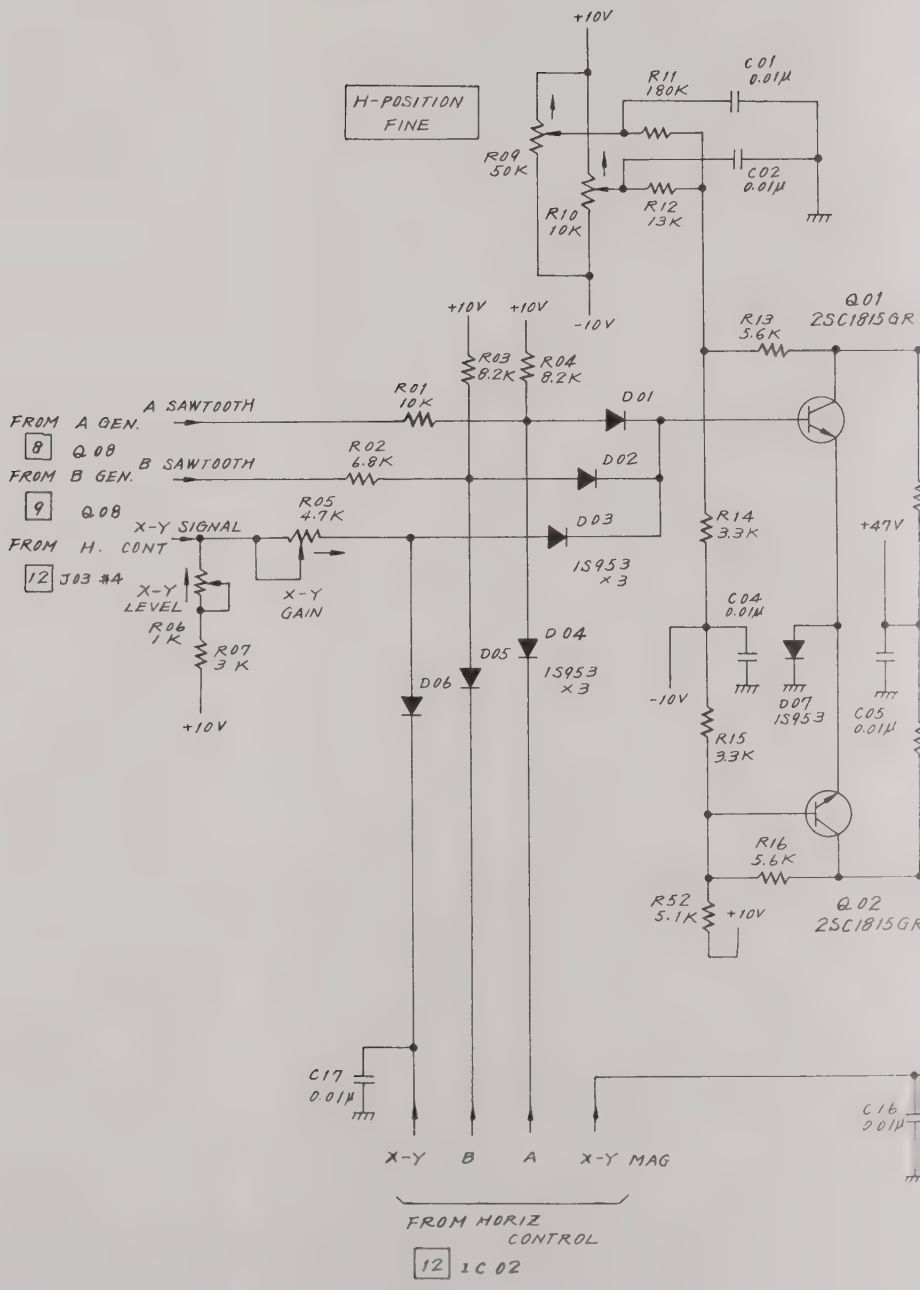
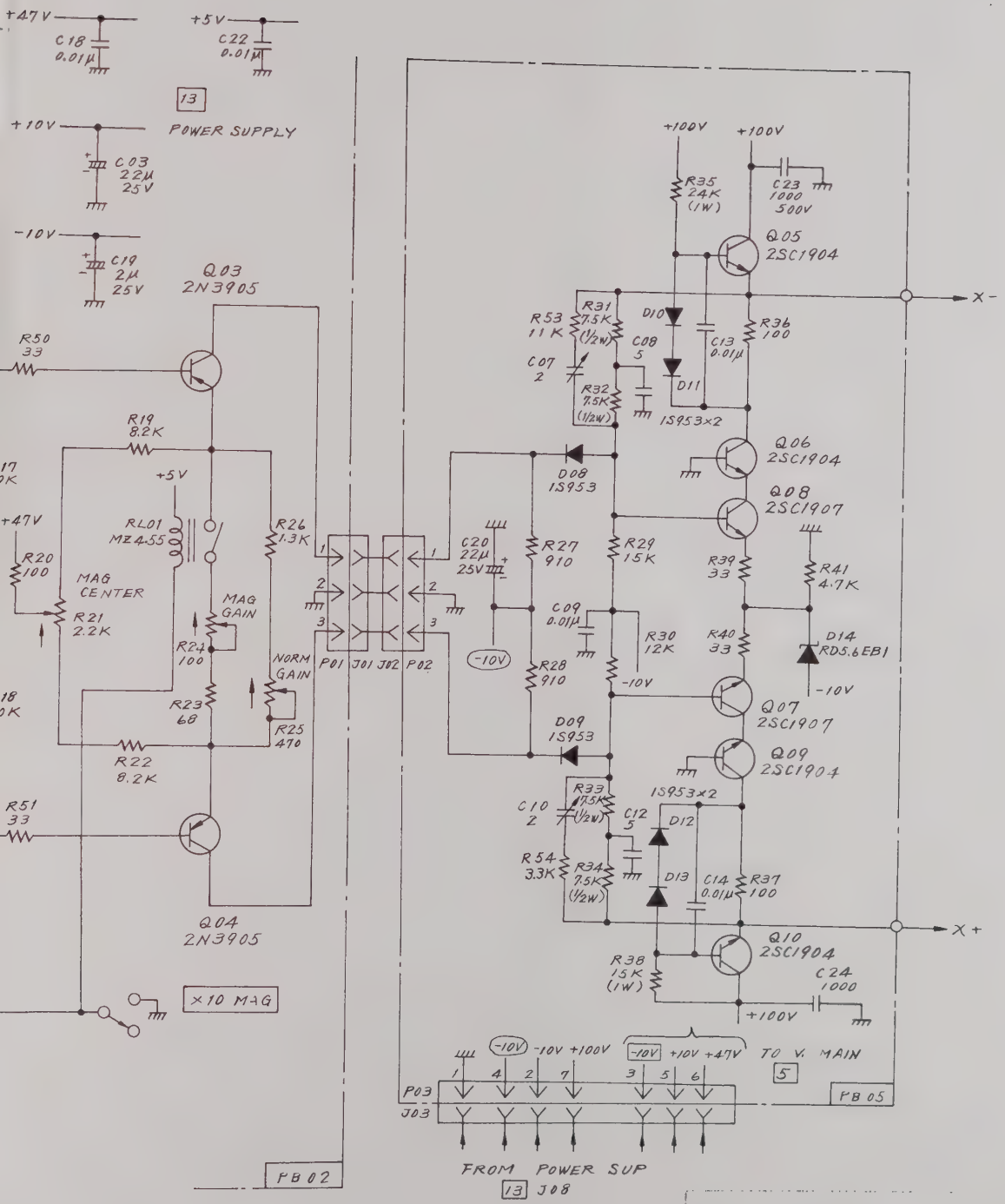
A&B TIMING CIRCUIT 10

BBWSS20009102


+10V
H-POSITION FINE
R09 50K
R10 10K
R11 180K
C01 0.01μ
C02 0.01μ
R12 13K
-10V
+10V
+10V
R03 8.2K
R04 8.2K
Q01 2SC1815GR
R13 5.6K
A SAWTOOTH
FROM A GEN.
8 Q08
B SAWTOOTH
FROM B GEN.
9 Q08
X-Y SIGNAL
FROM H. CONT
12 J03 #4
R01 10K
R02 6.8K
R05 4.7K
D01
D02
D03
1S953 x3
X-Y LEVEL
R06 1K
R07 3K
X-Y GAIN
D04
D05
D06
1S953 x3
R14 3.3K
+47V
C04 0.01μ
D07 1S953
C05 0.01μ
-10V
R15 3.3K
R16 5.6K
R52 5.1K
+10V
Q02 2SC1815GR
C17 0.01μ
C16 0.01μ
X-Y
B
A
X-Y MAG
FROM HORIZ CONTROL
12 IC02



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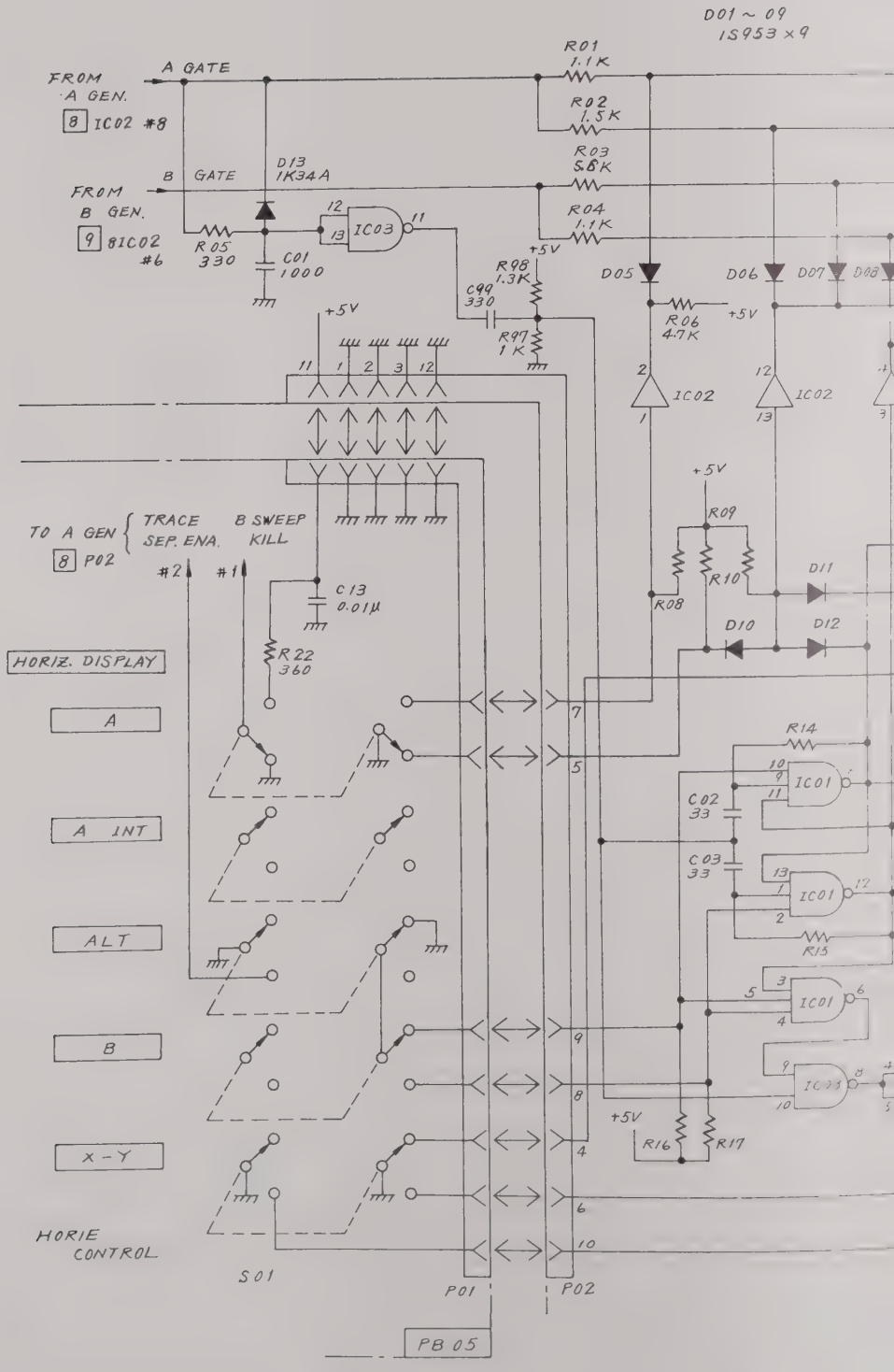
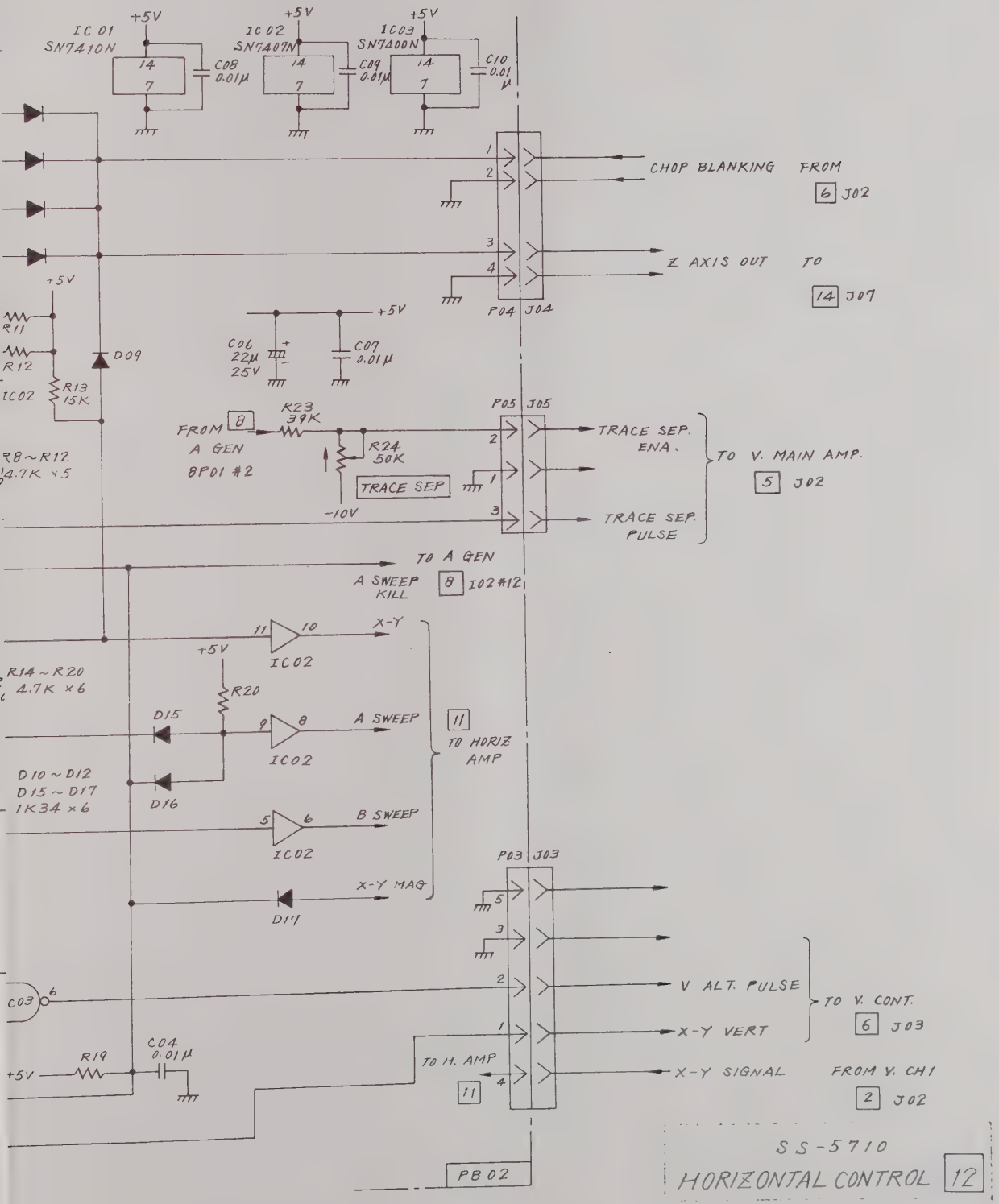
HORIZONTAL AMPLIFIER 11

BBWSS24025102


D01 ~ 09
1S953 x 9
FROM A GEN.
8 IC02 #8
A GATE
B GATE
FROM B GEN.
9 8IC02 #6
D13 1K34A
R05 330
C01 1000
IC03
R01 1.1K
R02 1.5K
R03 5.6K
R04 1.1K
R98 1.3K
C99 330
R97 1K
+5V
D05
D06
D07
D08
R06 4.7K
IC02
TO A GEN 8 P02
TRACE SEP. ENA.
B SWEEP KILL
#2
#1
C13 0.01μ
R22 360
R09
R10
R08
D11
D10
D12
HORIZ. DISPLAY
A
A INT
ALT
B
X-Y
HORIE CONTROL
S01
P01
P02
PB 05
R14
IC01
C02 33
C03 33
R15
R16
R17



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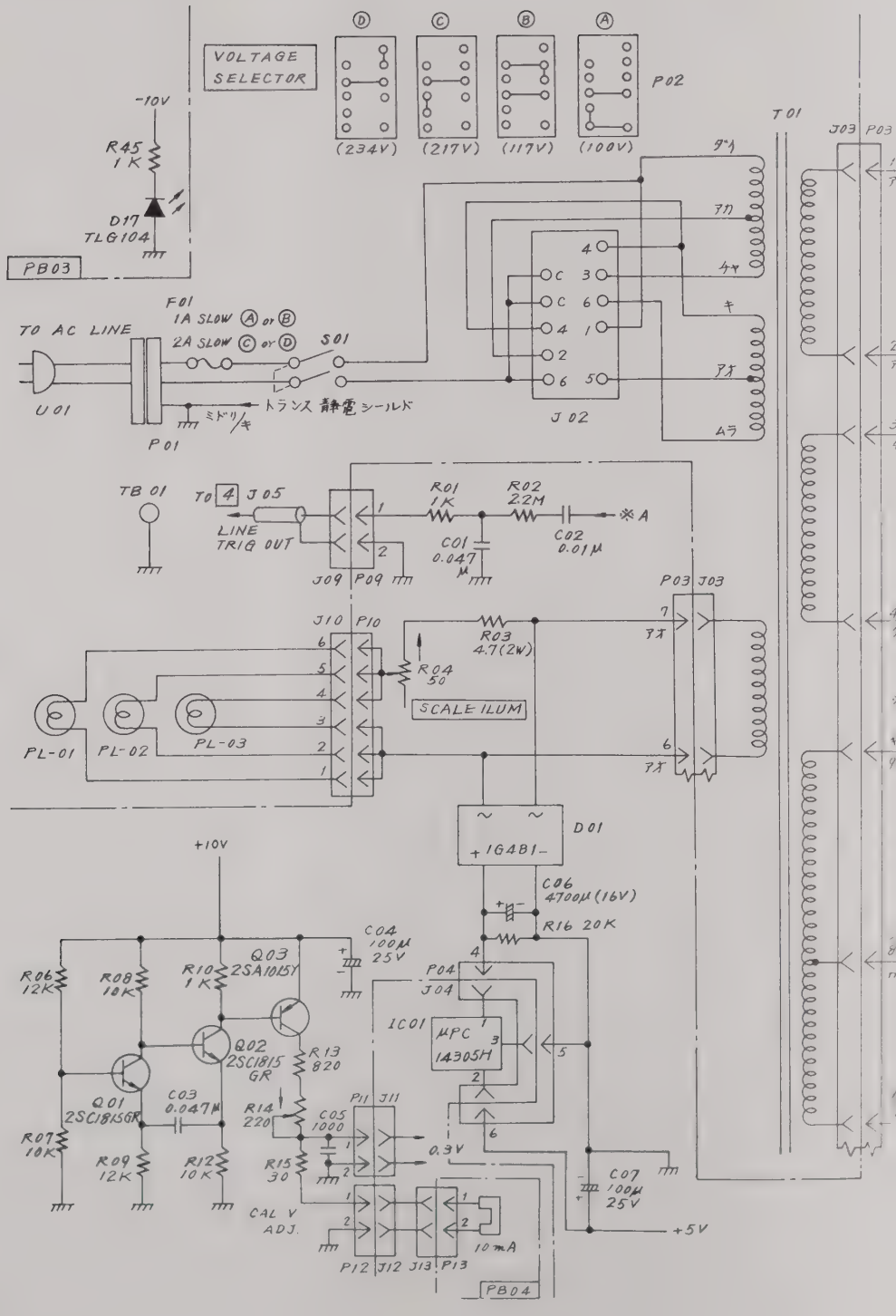
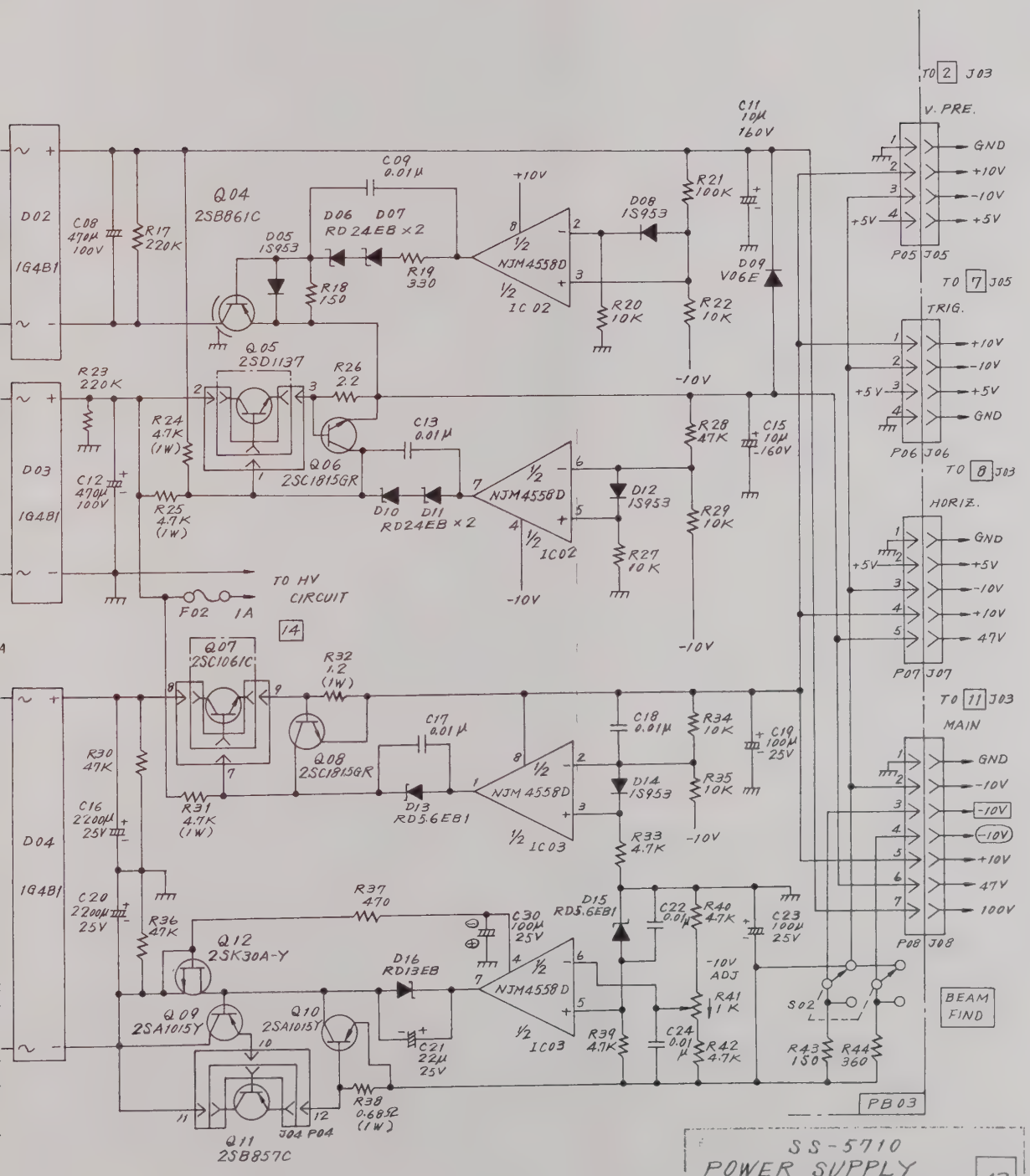
HORIZONTAL CONTROL 12

BBWSS10005102


VOLTAGE SELECTOR
Ⓓ Ⓒ Ⓑ Ⓐ
P02
(234V) (217V) (117V) (100V)
-10V
R45 1K
D17 TLG104
PB03
T01
J03 P03
F01 1A SLOW Ⓐ or Ⓑ 2A SLOW Ⓒ or Ⓓ
TO AC LINE
S01
U01
P01
ミドリ/キ
トランス 静電シールド
J02
TB01
TO 4 J05
LINE TRIG OUT
J09 P09
R01 1K
R02 2.2M
※A
C01 0.047μ
C02 0.01μ
J10 P10
R03 4.7(2W)
R04 50
SCALE ILUM
PL-01 PL-02 PL-03
D01 +1G4B1-
+10V
C06 4700μ(16V)
R16 20K
C04 100μ 25V
R06 12K
R08 10K
R10 1K
Q03 2SA1015Y
Q02 2SC1815 GR
Q01 2SC1815GR
R13 820
R14 220
C03 0.047M
C05 1000
R07 10K
R09 12K
R12 10K
R15 30
P04 J04
IC01 μPC 14305H
P11 J11
0.3V
CAL V ADJ.
C07 100μ 25V
+5V
10mA
P12 J12 J13 P13
PB04



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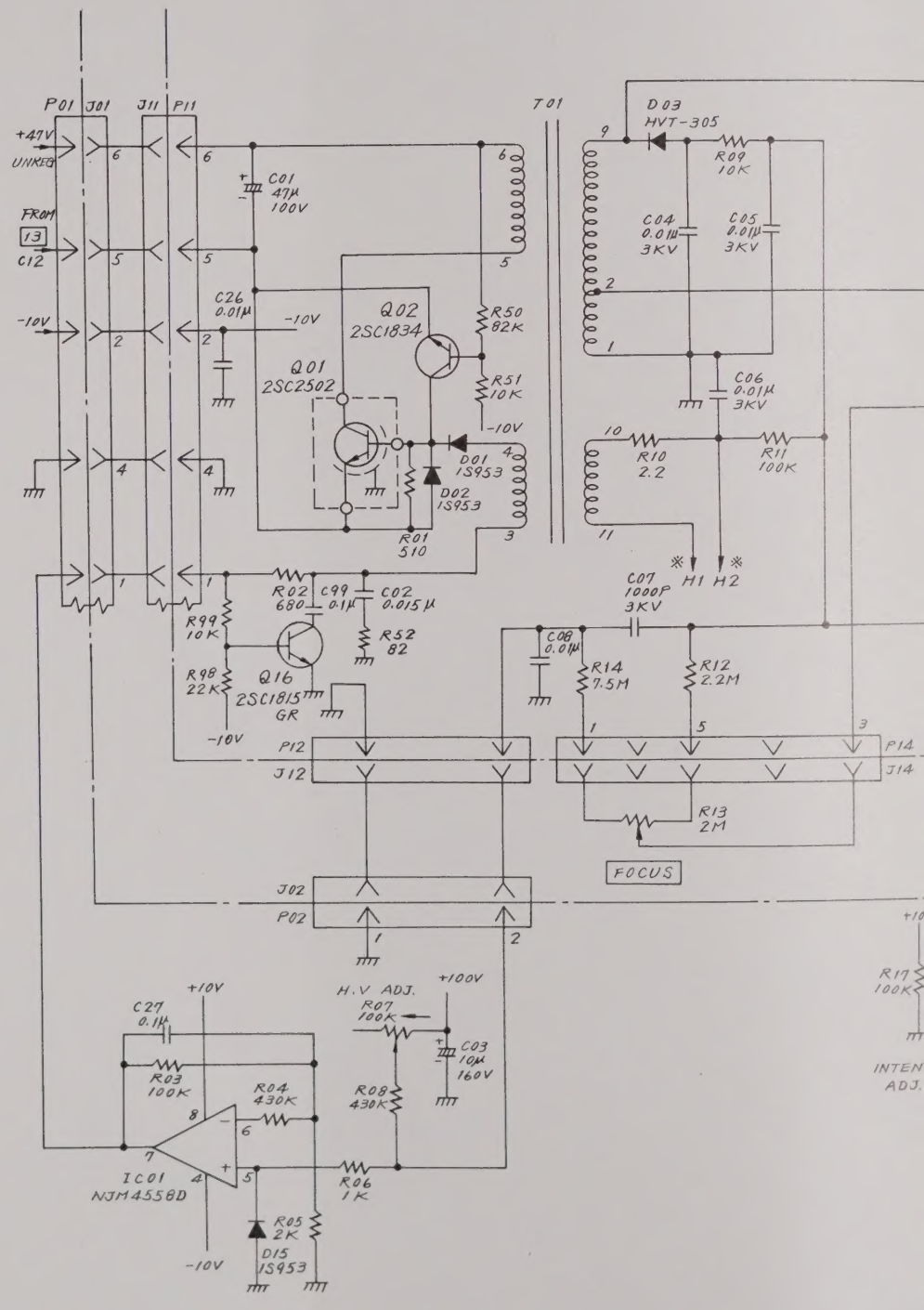
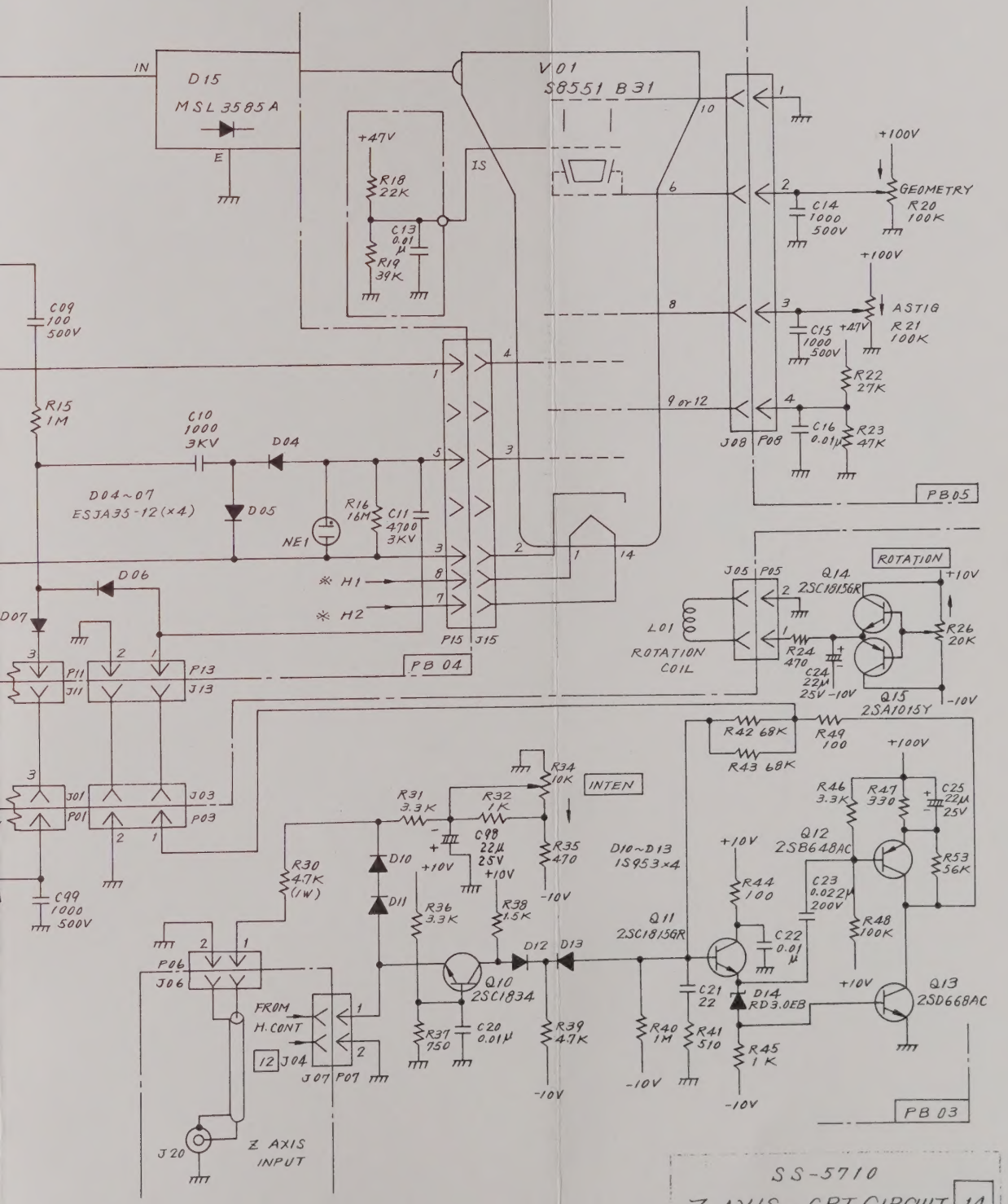
POWER SUPPLY
& CALIBRATOR
13

BBWSS0806102


P01
J01
J11
P11
+47V
UNREG
FROM
13
C12
-10V
C01
47μ
100V
C26
0.01μ
Q02
2SC1834
Q01
2SC2502
R50
82K
R51
10K
D01
1S953
D02
1S953
R01
510
T01
D03
HVT-305
R09
10K
C04
0.01μ
3KV
C05
0.01μ
3KV
C06
0.01μ
3KV
R10
2.2
R11
100K
C07
1000P
3KV
H1
H2
R02
680
C99
0.1μ
C02
0.015μ
R52
82
R99
10K
R98
22K
Q16
2SC1815
GR
C08
0.01μ
R14
7.5M
R12
2.2M
R13
2M
P12
J12
P14
J14
FOCUS
J02
P02
+10V
C27
0.1μ
R03
100K
R04
430K
IC01
NJM4558D
R05
2K
D15
1S953
R06
1K
H.V ADJ.
R07
100K
C03
10μ
160V
R08
430K
+100V
R17
100K
INTEN
ADJ.



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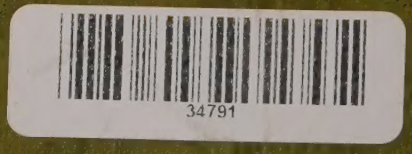
Z AXIS & CRT CIRCUIT 14

BBWSS41002102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